McGraw-Hill
Publishing Company, Inc.
James H. McGraw, *President*
Mason Britton, *Vice-President*

POWER

Editor
Fred R. Low
Associate Editors
C. H. Berry
A. D. Blake

Volume 67 New York, June 12, 1928 *Number 24*

Getting Things Done

I BELIEVE I have written a foreword under this title before, but this is a different thought.

The complaint is common on the part of engineers that they cannot get things done to their plants—even the necessary things, to say nothing of improvements in cleanliness, comfort and appearance.

A recent foreword on "Presentability" and an editorial on "Spring Cleaning" in the May 15 issue have brought out interesting comment.

To the advantages of fixing things up, enumerated in the editorial, might have been added the enhanced importance of the engineer in the minds of the management.

If he allows the power house to be a dirty, forbidding clutter hole that the boss avoids when showing his friends through, something of the character of his department will fasten upon himself in the minds of the executives. They will not consider a high-class man willing to work in such surroundings.

A manufacturing company paid a consulting engineer a considerable fee for advising them to do what their engineer had been urging them for a long while to do.

When I tried to get from him his explanation of his failure to put it over—his idea of the cause of their lack of confidence in him—he said: "Oh, they see me in my working clothes."

All live owners and managers are interested in efficiency. Their pocket nerves are sensitive; but when they are losing money and do not know it, they do not worry.

Suppose an engineer should induce the boss to take a walk through the plant and should show him how certain things are rapidly wasting out for lack of upkeep and refurbishing.

Suppose he should give him a dollars-and-cents idea of preventable wastes that are obviously going on.

He could get him worrying, and if he had a good case, well presented, he could get things done.

And the boss would be convinced that there was more in that engineer than he had credited him with.

F. R. Low

Today's Accidents—Yesterday's Design

PRACTICE in the design and manufacture of equipment is usually several months or several years ahead of that represented in equipment that is operating today.

A machine fails, doing more or less damage in the process. Thereupon everybody condemns its manufacturer as incompetent or careless, or ignorant, or what have you? As a matter of fact, if the accident indicates anything concerning the manufacturer's ability or knowledge, it must be borne in mind that the indication refers to his condition several years ago. Particularly in the case of large power machinery, a new machine going into service today probably embodies many features of design that were worked out three or four, or even five, years ago and are only now coming to the actual test of continuous operation. Today's accident may easily represent the incomplete knowledge of several years ago.

In railing at the manufacturer because of present accidents, therefore, one is really berating the ghost of days gone by. Present practice is better than past practice.

Of course the manufacturer studies accidents to his equipment and compares his present practice with that represented in the equipment that has failed, and thereby he learns much and does greatly improve his methods and broaden and deepen his knowledge. That he knew less five years ago than he does now is by no means discreditable; on the contrary, it is the highest credit to the manufacturer that he knows more today than he knew yesterday, and is continually growing in his grasp of all the complicated mass of details that is involved in building first-class machinery.

Moreover, in the power field, the manufacturer is beset by rising steam pressure and temperature and increasing demand with respect to continuity of operation under unfavorable circumstances.

Don't blame the manufacturer just because something he built some time ago has given trouble. Perhaps he no longer builds it that way. That his knowledge and experience fell short five years ago is no reflection on his ability or integrity, provided the shortcomings have been made up in the meantime.

Don't wave the red shirt—keep it on.

Industry Sweeps On

NOT long ago a scientist threw on the screen a wonderful motion picture of the multiplication of microbes as viewed through a microscope. The picture was speeded up to show in a few minutes what took hours in actuality.

First appeared a single germ shaped something like a sawed-off log. This grew in length and soon broke into two smaller "logs." These again grew and divided, giving four in all. The four became eight and the eight, sixteen. Soon the makings of a modest "log jam" were evident in the center of the screen. The breaking off of new individuals and their growth continued in this geometric ratio until, with a last expansion of startling rapidity, microbes covered the whole visible area with a solid mass of black.

The analogy is not perfect by any means, but the accelerated growth so graphically displayed by this film reminds one of the growth of science and its industrial applications. For centuries science and industry moved so slowly that they seemed to be standing still. Today the civilized world is literally seething with the expansion of ideas into actualities in the shape of new processes, better machinery and more efficient methods.

These physical changes are necessarily accompanied by a change in the management personnel of industry. The ruthless sweep of economic law is weeding out those who cannot or will not see clearly, think straight and act with swiftness. Such must live and will find their own little eddies along the shores of the industrial stream, but mastery of the swift current is not for them.

There is a personal danger here for some of the old timers who have not kept pace with recent developments. Can the man who has worked for years with steam pressures of one hundred pounds, or two hundred at the most, examine with an open mind the possibilities of six hundred pounds or twelve hundred? Can the steam-trained engineer weigh fairly the advantages of oil engine power? Can one trained to think only of the power "house" get the broader picture of the real power "plant" with its arteries of steam, water, refrigeration, mechanical transmission and electricity reaching out to thousands of process applications?

Fortunately, it is not a matter of gray hairs but of mental attitude. Some of our older engineers are proving by their actions that this is more than a pretty theory. And they will share in the improved industrial efficiency.

Circulation in Boilers

THE question of the circulation of the water in boilers has been receiving close attention by those interested in the development of new and better boilers. This problem has presented itself in a new way in connection with boiler surfaces inclosing furnaces and hence subject to both radiant and convection heat. It also appears in boilers for high pressures where the size and density of the bubbles of steam may seriously affect circulation.

With modern water-tube boilers, one can assume that the feed water is heated as close to boiler temperature as possible in a particular plant. Aside from this further heating of the feed water, in the final analysis circulation in the boiler is desired solely to remove the steam from the heating surfaces and to carry this steam rapidly to the outlet of the boiler. It seems obvious that there can be no difficulty in absorbing all the heat conveyed through boiler surfaces if these are completely covered with water at all times. The difficulty arises when steam bubbles form on these surfaces and retard the absorption of heat or when these accumulated steam bubbles do not find an easy path to the drum, choke the tube, and convert it into a superheater instead of a water evaporating surface. Circulation is therefore necessary to sweep these bubbles away and to keep the heating surface always wetted.

With low steam pressures and moderate ratings it was not a difficult matter to provide all the circulation necessary. However, water-cooled furnace walls, high ratings and increased boiler pressures have introduced new problems. The effect of radiant heat absorption on boiler surfaces has been much discussed, and questions have been raised regarding the character, nature and flow of the mixtures leaving boiler and side-wall tubes. With extensive water-cooled boiler walls and particularly with increased boiler pressures, can the matter of the removal of the steam bubbles generated be left entirely to circulation induced by natural causes in the design of the boiler? The alternative is forced circulation. This introduces another auxiliary in the operation of the boiler and should be resorted to only when engineers are convinced that natural circulation is no longer sufficiently satisfactory.

Tailor-made Turbines

MUCH was heard, a number of years ago, of the desirability of standardization of steam-turbine sizes and types. The manufacturers argued that standardization would lead to lower initial costs since new and special turbines always required large expenditures for design and development. They had much reason in their claims, and if these standardized turbines had been universally adopted, customers could have purchased cheaper turbines, while the manufacturers would have made larger profits due to standardized manufacturing methods.

Progress, however, often causes the best-laid plans to be upset. This propaganda for standardization had hardly been widely disseminated when designing engineers began to consider the use of higher steam temperatures. Bleeding and reheating methods were also applied to turbines. These developments have required individual designs for almost every large turbine since nozzles and blading must be designed for bleeder conditions to secure best economy. Large turbines are now generally "tailor-made" for the conditions under which they will operate.

Education of the industrial user of steam turbines has also progressed rapidly. Industrial engineers now understand and appreciate the advantages of using bled steam and exhaust steam for industrial heating, and also of returning waste steam, when available, to turbines. Cheap byproduct power secured by the use of high-pressure steam is becoming more common. Turbines for industrial plants are thus also becoming "tailor-made."

What will be the result of this trend? Undoubtedly, many standard frames can be used for several types and outputs of turbines. Manufacturers in this country are gradually approaching the status of European turbine builders, where each turbine is an individual problem and is built to fit the assumed operating conditions. This, however, adds to the cost of the machine, a fact that purchasers must appreciate and be willing to meet.

Direct-Current Motors Stage a Comeback

CONTRARY to the general belief, the use of direct-current motors is on the increase. Outside of railway work they deliver thirty-one per cent of the power in industry and represent in numbers thirty-six per cent of the motors in operation. At one time many engineers were of the opinion that the days of the direct-current motor were numbered, and even today this idea prevails to a certain extent.

The extreme simplicity of the squirrel-cage type polyphase alternating-current motor has attracted to it a great deal of attention. This machine has inherently a constant speed, but many power applications require adjustable speed. All attempts to obtain adjustable-speed alternating-current motors have led to complications of commutators and slip rings that surpass the commutator of the direct-current machine. Even so the alternating-current motor does not possess the flexible speed-adjustment characteristics of the direct-current machine.

Speed control is not the only reason for using direct-current motors. In many industrial plants direct current is generated and here direct-current motors are used almost exclusively.

In applications where dynamic braking is required, direct-current motors offer many advantages over alternating-current types. Where close speed control is to be maintained, as in high-speed elevator service, the direct-current motor with variable-voltage control has no competitior.

For such applications as are found in steel mills, on paper machines, large hoists and in other places, the flexible control of the direct-current motor has won it an ever increasing list of installations. In the rolling of steel and the operation of large hoists with the advantage of flexible speed control of direct-current motors is combined that of the motor-generator set which provides a means of absorbing the peak loads without reflecting their effects in the alternating-current power system.

Where alternating current is available, a motor-generator set must be used to convert to direct current. If this is driven by a synchronous motor, the corrective effect of the motor on the power factor of the system will compensate largely for the comparatively low efficiency of the set.

Like the original direct-current system, alternating current does not meet all the requirements of industry. Both have desirable features, and it is the job of the power engineer to combine these to obtain the most satisfactory power system for any given set of conditions.

The Other Side of the Power Picture

MANY industrial processes require heat in large quantities in the form of steam, heated air, hot water, electricity or the direct heat from fuel. It is not uncommon that careful engineering consideration is given to the production of heat and power generation, while the applications are passed over with only secondary attention. Yet in the boiler plant heat can be applied about as efficiently as ever will be possible. Boilers and furnaces can be operated so that over 90 per cent of the heat in the fuel is delivered in the steam.

Following out through manufacturing processes, it will be frequently found that the most inefficient part of the plant's operation is in the application of heat to the production of goods. Although there are opportunities for saving fuel in the power house, there are even greater opportunities in the use of heat and power in the processes. It is here that large savings can be made by lower labor costs, increased production, improved product and decreased spoilage, as well as by direct elimination of waste power and heat. All these tend toward lower costs of the finished product, which should be the criterion of how efficiently the plant is operated.

In some of the processes it is possible to increase the unit cost of heat a number of times and obtain a better product at a lower cost, which is contrary to the old idea of reducing costs by keeping down the amount of fuel used. It is all very well to have an efficiently designed power house and to operate it according to the best practice, but unless this standard follows all the way through to the finished product, the money saved in the power house may be wasted many times outside.

The economical design and operation of a manufacturing plant, requiring a number of services such as power, process steam and heat, is not centered in the efficiency of the individual services, but in the co-ordination of all the requirements to produce goods with the highest economy. To do this requires that the entire process from the coal pile to the finished goods be engineered as a unit.

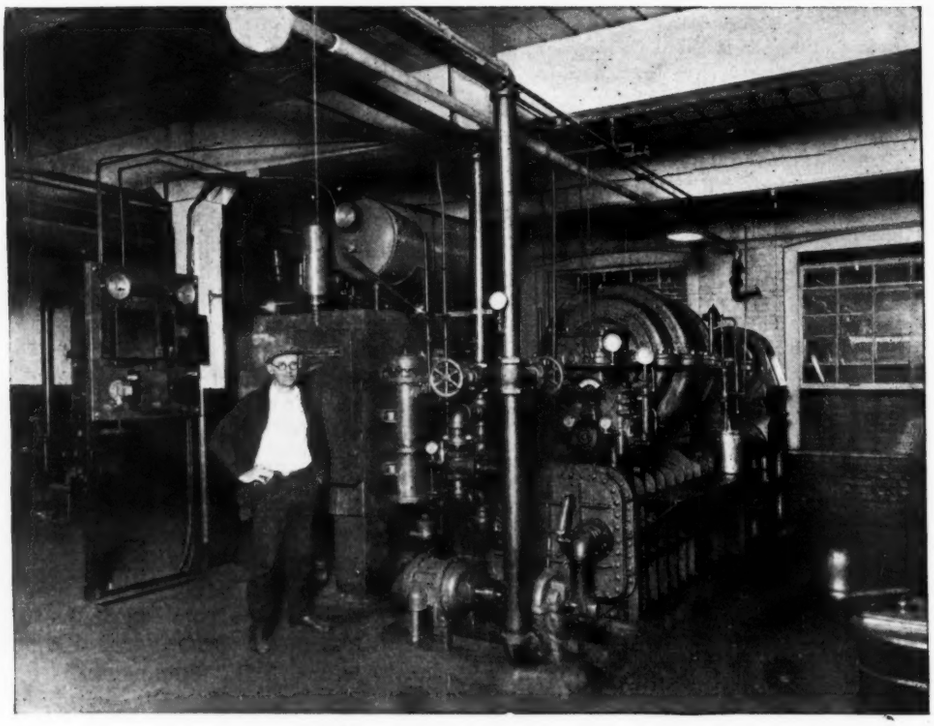


Fig. 1 The centrifugal-compressor refrigerating plant in the Nunnally plant

Manufacturing Weather

In a Candy Factory

By C. T. Baker
Consulting Engineer, Atlanta, Ga.

SOMEONE has remarked that the lack of refrigeration prompted Columbus to discover America. The argument is that in those days ice and refrigeration were unknown in Spain and the rest of Southern Europe; food tainted easily, and to make it palatable, vast quantities of pepper and spices imported from Asia were used. Columbus ran across America while seeking the spice countries; proper refrigeration would have held him at home. Regardless of how true this may be, refrigeration plays a most important part in modern industry, and few have full understanding of the importance of mechanical refrigeration outside the field of preserving food products, such as is done in the cold-storage industry. Almost every industry has found the use of refrigeration in its processes.

One of the outstanding examples of the use of refrigeration to improve finished products is found in the candy industry. This industry, using as it does many delicate ingredients, such as butter, fruits, cream, nuts, cocoa beans and spices, must be surrounded by the best sanitary conditions. Temperatures must be kept so low that danger from worms and insects is eliminated. In addition to this, dipping rooms, packing rooms and storage rooms call for accurate temperature and humidity control and a supply of fresh air from which all dirt and other foreign matter have been removed.

One of the most up-to-date applications of refrigeration to candy manufacture is found in the factory of the Nunnally Company, Atlanta, Ga.

This company was organized in 1885 by J. H. Nunnally and began the manufacture of candies in a small plant, where the business was continued until 1903, by which time the original space and manufacturing facilities were inadequate to accommodate properly the fast-growing business the company had developed. A new plant was designed, and in 1903 the first unit of the ultimate development was erected, consisting of one five-story building, 260 ft. long by 40 ft. wide, which housed all the manufacturing and executive operations. Since that time four additions have been made, which have greatly increased the manufacturing capacity, so that today the plant has a combined floor space of 100,000 square feet.

The new development included in its design a complete refrigerating plant for cooling and conditioning the air used in several of the various rooms of the build-

ings, as well as for cooling the chocolate previous to packing.

The original refrigerating plant was an ammonia-absorption plant and operated satisfactorily for a number of years, but as the business continued to grow and additional space was needed, a larger refrigerating plant installation was necessary. Since the ultimate development would require the conditioning of air for approximately 400,000 cu.ft. of space, it became necessary to install a more modern type of plant, one in which temperatures and humidities were automatically controlled and one which would insure proper air conditioning at all times for all rooms, regardless of the temperature and humidity of the outside atmosphere.

In order to provide the necessary refrigeration for this purpose, a refrigerating and air-conditioning plant was installed.

The refrigerating machine proper consists of one Carrier 75-ton centrifugal compressor, driven by a 100-hp. 220-volt three-phase 60-cycle G.E. motor, through a Terry speed-increasing gear having a speed ratio of 1 to $2\frac{1}{8}$. The compressor is mounted directly on top of a multi-pass condenser which receives the discharge vapors from the compressor and condenses them under a vacuum of approximately 26 inches.

The Nunnally Company controls the temperature of the air in its candy factory by refrigeration.

Regardless of the month, the air temperature of the factory room is held at 70 deg. F.

Air conditioning keeps the humidity at 42 per cent while the candy is being packed.

The humidity and temperature of each room are controlled automatically.

The refrigerant used in the Carrier system is called "Dielene" and is particularly advantageous for use in connection with the centrifugal-type compressor, since the entire refrigerating cycle occurs under a vacuum or at sub - atmospheric pressure. Consequently, any leakage occurring in the refrigerating system will be inward rather than outward and, therefore, there will be no escape of the refrigerant into the room where the machine is located. This refrigerant is safe and has no disagreeable odor, neither is there any fire hazard attached to its use, as it will not support combustion.

Next to the compressor is the evaporator, in which the refrigerant is evaporated to produce the necessary low temperatures required for cooling the water used in the reconditioning of the air.

In Fig. 1 is a part of the machinery room showing the centrifugal compressor mounted on the condenser, to the left of which is the evaporator.

The condensing-water circulating pump is shown immediately in front of one end of the condenser and is of 250 g.p.m. capacity when pumping against a head of 70 ft. This pump was manufactured by the Buffalo Pump Company and is direct-driven by a 10-hp. G.E. 1,800 r.p.m. three-phase 60-cycle motor.

Since the speed of the motor driving the compressor is varied according to the refrigerating demands by means of the controller shown to the left of the condenser, the amount of water circulated through the condenser is varied somewhat to suit the conditions. Ordinarily, the water enters the condenser at a temperature of 66 deg. F. and leaves at a temperature of 81 deg. This, however, depends upon the amount of refrigerating tonnage being performed, which varies according to the season of the year and the volume of candies being manufactured.

The opposite end of the refrigerating unit and the method of supporting the motor and reduction gear are shown in Fig. 2.

The dehumidifier is in the refrigerating machinery room and is provided with a large intake duct in which is placed a damper to control the amount of outside air brought into the air-circulating system. The operation of this damper is entirely automatic and will be referred to later. The dehumidifier is equipped with the necessary apparatus such as baffles, eliminators, interior piping, spray nozzles, strainers, drain and overflow connections.

The water to be cooled is circulated through the evaporator by means of a $2\frac{1}{2}$-in. double-suction 100-ft. head centrifugal pump driven by a 10-hp. 1,800 r.p.m. 220-volt 60-cycle three-phase motor. This pump takes its suction from the dehumidifier proper, delivering the water to the evaporator at a temperature of 43 deg. and returning it to the dehumidifier at a temperature of 38 deg. This, however, is not a fixed condition and may be varied when desirable.

Air to be conditioned is taken in at the inlet end of the dehumidifier and passes through the cold water, which is sprayed by means of nozzles in such a manner as to cause an intimate mixing of the air and water while the water is descending to the bottom of the dehumidifier. After the air has completed its passage through the dehumidifier, it is delivered by a full-housed conoidal fan, operating at a speed of 325 r.p.m., belt-driven by a 10-hp. 1,200-r.p.m. three-phase motor. The actual brake-horsepower required at the fan shaft is 8.5.

The water lines are $3\frac{1}{2}$ in. in diameter, and the water-circulating pump is in close proximity to the dehumidifier. Placed next to the dehumidifier is the Carrier dewpoint-control apparatus, which includes a small vertical air compressor driven by a $\frac{1}{2}$-hp. motor, as well as the necessary air tank, air filters, relief valve and thermostat air piping.

A galvanized-iron distributing air duct from the discharge side of the fan passes to the upper floors, where it connects to the various rooms supplied with conditioned air. From this main discharge duct distributing ducts are taken off for each room, and from each room served in this manner, a return duct removes the air, delivering it to one main return duct terminating at the inlet side of the dehumidifier.

After having performed its work, most of the conditioned air is returned to the dehumidifier, where it is again washed and cooled, ready for recirculating. An automatic damper in this return duct at the dehumidifier, is automatically controlled simultaneously with the damper in the duct bringing in air from the outside. Thus when the damper is being opened to the outside to admit outside air, there is at the same time a partial closing of the damper in the main return duct.

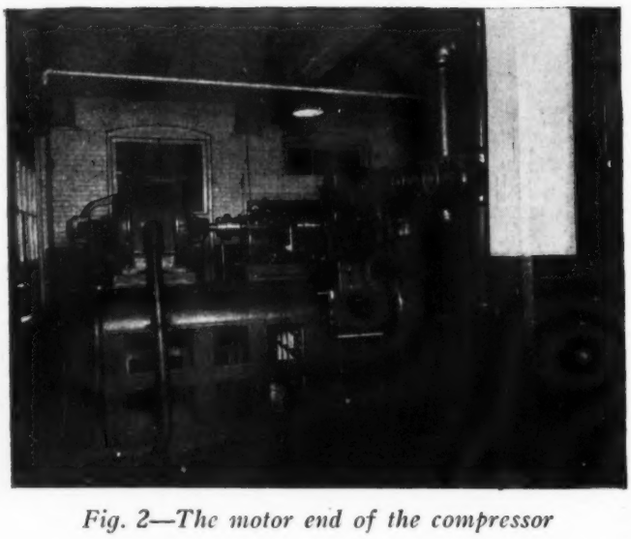


Fig. 2—The motor end of the compressor

In order to maintain ideal conditions at all times within the various rooms of the factory, all the air delivered must be washed clean. During the winter months the air must be heated and its moisture content increased to the fixed standard required by the different departments, a condition quite the opposite to that existing in summer, when the air must be cooled and its moisture content reduced to a fixed standard.

The entire operation is under the control of a dewpoint thermostat, the function of which is to regulate the flow of water through the condenser of the refrigerating machine so that this machine produces only the amount of refrigeration required and no more.

Since the power consumption of the compressor is proportional to the refrigerating load, it follows that with the refrigerating load automatically held at the minimum necessary for the work performed in the dehumidifier, the power consumption is also minimized.

The sides, top and bottom of the dehumidifier are insulated with 2-in. thickness of sheet cork insulation to prevent the unnecessary taking up of heat by the cooled water and air. The return and supply air ducts located outside the conditioned rooms are insulated in the same manner.

The plant was designed to cool the rooms to be conditioned in summer, as shown in the table, with the outside air having a dry-bulb temperature of 96 deg. F. and a wet-bulb temperature of 78 deg. The relative humidity to be maintained was not to exceed 50 per cent with a maximum outside entering wet-bulb temperature of 78 deg.

Another requirement of the equipment was to remove not less than 98 per cent of the solid matter, brought into the apparatus from the outside.

AIR-CONDITIONING DATA

Room	Temperature To Be Cooled Deg. F.	Relative Humidity Per Cent	Number of People in Room	Motors in Room, Hp.	Lights, Watts
Storage, 20x15 ft...	65	50	0	0	....
Starch.....	70	42	6	7	675
Apparatus.....	70	42	0	0	225
Hand dipping.....	65	50	30	¼	1,635
Hot side enrober...	80	35	12	4	450
Cool side enrober..	65	50	12	¼	450
Packing.....	70	42	75	4	3,150

The rooms to be cooled and conditioned were made airtight to prevent infiltration or air leakage, and white shades were provided at all windows to prevent the entrance of direct sunlight. In addition to cooling and conditioning the air for the rooms indicated in the table, the refrigerating plant was required to take care of certain raw materials introduced into the rooms as follows:

In the starch room 15 lb. of centers per minute are introduced at a temperature of 150 deg. F.

In the dipping room 8.33 lb. of chocolate per minute, having a temperature of 99 deg., and 5 pounds of centers per minute, having a temperature of 68 deg., are introduced.

Into the cool-side enrober room, containing three coolers, are introduced 16.6 lb. of chocolate per minute at 99 deg. and 10 lb. of centers per minute at 88 deg. To each of these three machines is supplied 1,500 cu.ft. of air per minute. The center storage room is required to take care of the cooling of 15 lb. of centers per minute introduced at a temperature of 70 deg.

The rooms into which the conditioned air is introduced are insulated with 2-in. sheet cork throughout, furnished by the Armstrong Cork & Insulation Company.

All windows are of triple-glass tight-fitting construction, designed to reduce heat and air leakage from the outside to a minimum.

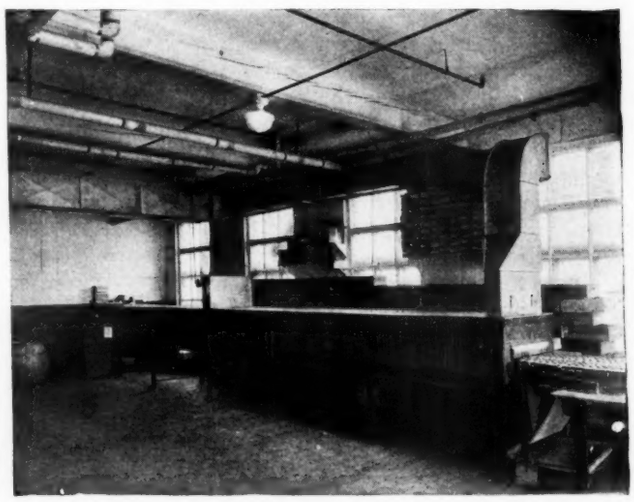
Candies Cooled Before Packing

The candies cannot be taken directly from the dipping rooms to the packing rooms, but must first be cooled to a certain predetermined value before they are ready for packing. The type of cooling and hardening machine for conditioning the candies preparatory to packing is shown in Fig. 3. Candies are delivered to this machine from the hand-dipping rooms and enrobers, where they are immediately cooled and set, which produces a fine color and gloss.

Clean, fresh air of controlled temperature and humidity values enters the machine at each end, only one inlet duct being apparent from the illustration. The air passes to the center and out into the room through the outlet duct, the opening of which is auomatically controlled to maintain a uniform temperature inside the cooling and setting machine regardless of the amount and temperature of the candies passing through per unit of time.

The outlet end is shown at the right, where the conveyor is discharging the cooled candies ready for the packing room. The candies are placed on the slow-moving conveyor at the opposite end of the cooling ma-

Fig. 3—The candy-cooling machine



chine, just beyond the wall shown in the photograph, and passes through the entire length of the coolers.

The other air inlet duct is also concealed by the partition wall, but is connected in substantially the same manner as the one shown at the right-hand end of the machine.

The Nunnally Company also manufactures a large volume of hard candies, and since high temperatures and high humidities spoil the gloss and make the sticks of candy soft and sticky, as well as causing them to lose shape, it is necessary that such candies be produced under conditions that insure the proper temperature and humidity.

In Figs. 4 and 5 are shown two views of the packing department, in which are assembled the various assortments of candies sold under the trade name, "The Candy of the South."

Steam Heating Coils Automatically Controlled

In Fig. 4 is shown the large air duct with the damper-controlled outlets which bring the conditioned air to this room. The air is removed to the dehumidifier by the duct shown in Fig. 4. The inlet to this duct is not apparent from the photograph, but is several feet to the right of the first window shown. The same ducts deliver and remove the heated conditioned air in the winter time. The inlet duct for each room in the factory supplied by conditioned air is equipped with the necessary steam-heating coils for heating the air in winter to the predetermined temperature. These coils are automatically controlled, so that only enough steam is admitted to raise the temperature of the air to the predetermined value and no more.

Conditioned air keeps the candies bright and glossy and prevents them from becoming soft and sticky. After they have been packed under the ideal conditions maintained in the packing room, they are removed to the storage room, where they are kept until such time as they are shipped.

The storage room is as carefully conditioned as the manufacturing departments, so that the candies are maintained in perfect condition. The temperature and humidity of this room are maintained automatically and without variation year in and year out.

Since the heating and humidity of all departments are controlled in winter as well as in summer, there are no cold and hot spots in the rooms where candies are being packed and stored. Therefore no candies are made soft and spoiled through overheating by being placed too close to a radiator.

Fig. 4—The packing department also has its air conditioned

Fig. 5—Another view of the room with the manufactured weather

Where an enclosure is heated or cooled, as the case may be, by properly conditioned air, and each cubic foot of space held at the optimum condition as regards both temperature and humidity, the quality of the finished product is always up to the standard set by the company.

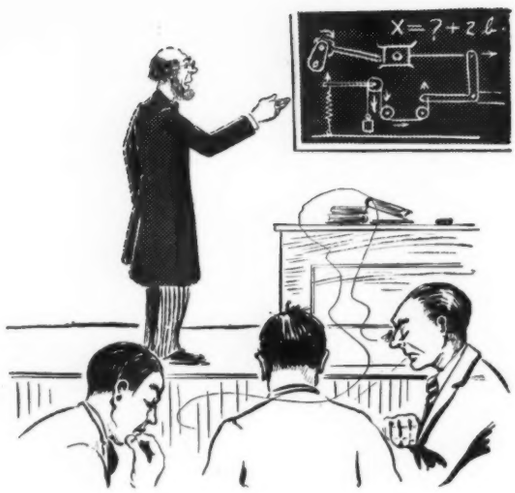
The heating in winter is by steam supplied to the various heaters at from 10 to 20 lb. pressure. The heaters are made up in sections and placed at the proper positions in the air inlet ducts supplying various rooms, and are provided with the necessary automatic temperature-control devices. The heaters are known as the Aerofin design and are constructed of seamless tubing having helical extended surfaces.

The officers and directors of the Nunnally Company are: J. H. Nunnally, chairman board of directors; Winship Nunnally, president; A. S. Hopkins, vice-president; F. C. Fenn, vice-president and secretary, and C. A. Rawson, vice-president.

For assistance in securing the data contained in this article, the author is indebted to A. R. Lackey, chief engineer of the company, Tresper Clarke, chemist, and J. P. Ward, superintendent, ice cream plant.

Proper Power Transmission Requires Study

F. H. WILLARD, president, Graton & Knight Company, Worcester, Mass., said over the radio on May 27, that "the offhand installation of forms of power transmission, which at first glance may appear to be panaceas for all kinds of transmission difficulties, should be discouraged. No such panacea has as yet stood the test of universal and continued application; the very nature of the transmission problem, involving, as it does, widespread and often conflicting phases, indicates the impossibility of the development of any such cure-all. Some of these promising innovations are nothing but fads, and in the end they will go the way of all fads; but meanwhile their installation is a costly luxury in which too many manufacturers are indulging themselves."



WHAT DO YOU KNOW?

By L. H. Morrison

The answers are on page 1068

Ques. 1—A boiler plant carrying 100 lb. pressure has trouble with calcium carbonate scale. Would the scale trouble be less or greater if the boiler pressure was raised to 150 lb.?

Ques. 2—What is a hotwell?

Ques. 3—Suppose you had run a series of boiler tests during which records were made of the CO_2, flue-gas temperature, water evaporated, etc. How could the records of the coal burned and flue-gas temperature be later used to ascertain the CO_2 per cent and the boiler efficiency?

Ques. 4—At what point in the piston stroke of a uniflow engine is the net steam pressure on the piston the smallest?

Ques. 5—What would you expect the radiation losses in a Corliss engine to be, in terms of per cent of the heat in the steam feed?

Ques. 6—Which type of prime mover has had the greatest yearly increase in horsepower of installations since 1920?

Ques. 7—Why do connecting-rod bolts of oil engines have fine threads?

Ques. 8—Water at 60 deg. F. exerts a pressure of 0.433 lb. per foot head. If a steam boiler has its gage reading 17.3 lb. and the water level in a hot-water heating system is 40 ft. above the hot-water boiler, which boiler will have the greatest pressure open if the thermometer shows 180 deg. F. as the temperature on the hot-water main?

Ques. 9—Should the thin edge of belt lap near the pulley point toward or away from the direction in which the belt is traveling?

Ques. 10—Where is helium, the gas used in airships, obtained? What properties make it very desirable for such use?

A Water Alarm That Always Works

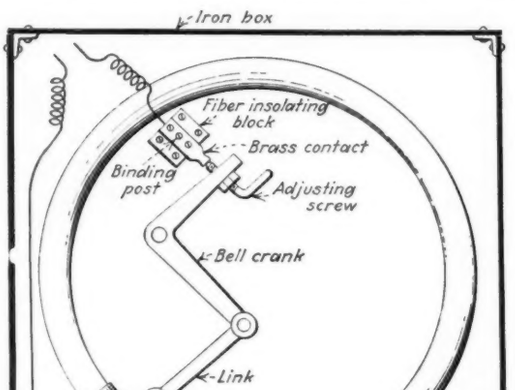
By O. W. Jennings

TO THE engineer familiar with oil-engine operation, one does not need to make any explanation as to what would happen if the lubricating oil or water circulation should stop without being detected by the operator. Piston seizures, cracked cylinder heads and burned-out bearings are not laughing matters. Hence, the need of a dependable under-pressure alarm system.

A number of these have been placed on the market, and I have tried them, but never found one that worked as well as the home-made device illustrated. It is just a piece of condenser tube, annealed, flattened and bent like the brass bow in a pressure gage. A small link, bell-crank and adjusting screw were attached as shown, as was also a brass contact carrying a binding post, and a fiber block. The device was placed in a galvanized iron box with a door to keep out the dust.

Pressure tends to straighten out the bow and break the contact, which is in a bell circuit. If the pressure should fail, contact will be made and an electric alarm would start ringing.

The advantage in using this contrivance is that there is no leakage, no sliding parts, such as piston, and nothing to stick or break. In short, it is dependable and



The low-water alarm as it was built

is neither expensive nor difficult to make. The adjusting screw on the ball crank makes it possible to set the alarm to ring at a given pressure. It has been in use only a year, and to date it has given no trouble.

Correction.—In the description of the Kalamazoo Steam Plant of the Consumers Power Company, which appeared in the Oct. 4, 1927, issue, the manufacturer of the ash sluicing system was given as the Beaumont Manufacturing Company. This was somewhat in error, as only the ash hoppers and gates were furnished by this company. The ash pumps used were manufactured by the Morris Machine Works, and the sluicing pump was by the American Steam Pump Company. The sluice proper is of concrete construction and was built according to plans of the plant designing engineers.

PIPE JOINTS
that will Hold at
High Pressures and Temperatures

By I. W. Whittle
Department of Engineering Design, Southern California Edison Company

THE high steam pressures and higher total temperatures that are used in modern power plants have introduced many new problems for the valve and piping designers. Large units in the boiler house as well as in the turbine room make shutdowns more serious and costly. Piping must be designed so that blown gaskets or leaks will not occur. A shutdown from any such cause cannot be tolerated.

Some of the present-day piping for high-pressure, high-temperature steam is made with weld-sealed joints. Practically all these joints are made under Sargol patent license. Engineers are confronted with the necessity of making a choice among the various types of these joints that are fabricated. Each of them has its advantages, a summary of which as they appear to the writer may be useful to designing and operating engineers. In the joints more generally used, the principal difference is in the type of lap formed when the pipe is bent over the flange. The 600-lb. joint has been considered here because it is the pressure standard that is most commonly used.

Weld-sealed pipe joints for high steam pressures and temperatures insure both tightness and strength. These joints may take many forms, each having its advantages or "talking points." Read what Mr. Whittle has to say about them from the user's viewpoint.

There are two general classes of joints, one in which the pipe is upset or thickened in the forging process and the other in which the pipe is left actual thickness and rolled out to form a flange or lap. The square-corner or square-lap type, in which the metal is upset or thickened, is probably the most popular. This is specified with parallel faces front and back of the lap or with a sloping back.

Round Type Lap

Fig. 1 shows a joint made without upsetting. The method of fabricating this joint is to machine the bore and face of the forged-steel flange and use it in place of a die over which to bend a round corner lap. The back face of the lap coming in contact with the flange is not machined, as it is maintained that the removal of this material would release what is known as "skin-tension" of the material and weaken this section of the joint. The pipe and flange are heated together to a definite temperature before the Van Stoning process is performed. It is claimed that this method prevents the pipe from being chilled too rapidly or shrinking to such an extent that the clearance is too great.

After the pipe and flange have been heated to a temperature of 1,800 deg. F., the forming of the lap is started and is stopped when the temperature drops to 1,350 deg. F. Temperatures are checked with an optical pyrometer. As may be seen in Fig. 1, the rolling of the lap without upsetting the pipe produces a lap that is thinner than the pipe wall.

The neck of the pipe is tapered to conform to the machined flange but the clearance maintained is not too small to prevent the flange from being rotated. The reason for tapering the neck of the pipe is to prevent complete rupture of the joint in case of failure of the lap. Tests indicate that the force required to draw the pipe through and clear of the conical bore is five times the pressure that would have occurred due to the steam pressure existing in the pipe. It is believed by partisans of the round type of lap that the metal is not so severely punished in forming this lap as in the case of the square joint.

Welding lips on this type of joint are formed by machining the adjoining edges of the laps to a V shape, into which additional metal is welded to form a seal. Actual tests of chipping open and rewelding this form of welding lip indicate that this operation can be carried on as many as five times before the lips are damaged to such an extent that they are no longer of value for sealing by welding.

Square-Corner Joint

The square-corner type of joint, as manufactured by upsetting and forming the lap against dies in a machine, is shown in Fig. 2. The heels of the two laps form a continuous inner wall in which there will be no pockets for collecting sediment and condensate. This forms a rigid joint with no possibility of bellows action due to expansion in the pipe. There is also more metal in this joint to form a bearing surface for the abutting laps.

It is the opinion of engineers who favor the square-lap joint that the fiber structure of the metal will not be ruptured, and that there will be no slag inclusions in

forming this square-lap joint when the metal is worked at the correct temperatures. The back face of the lap, forming a bearing surface for the flange, is slightly tapered and faced off to insure the flange bearing first on the innermost part of the back face of the lap.

Relatively long tapered lips are provided on the outer edges of the adjoining flanges, and no additional metal is required for the first welding, as the metal lips simply

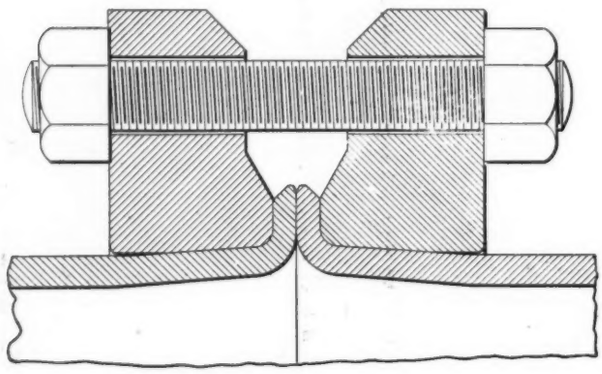


Fig. 1—Round lap joint made without upsetting

are fused together. It is the contention of users of this method of welding that the thin section of welding lip prevents uneven heating of the lap and a separation of the flanges around their inner periphery.

Spherical-Seat Joint

A recently developed new type of joint is shown in Fig. 3, in which the upsetting of the pipe is carried farther than in the square-corner type. A spherical seat for the flange is used in this joint. There is more metal in the heel of this lap in the section where the greatest shearing stress is believed to exist. The spherical-flange

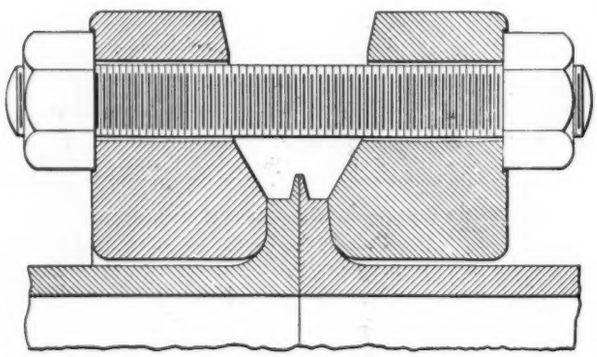


Fig. 2—Square corner joint with long tapered lips on outer edges of flanges

seat assures fair seating of the flange and tends to shift the maximum stress due to bolting toward the pipe wall and away from the periphery of the flange.

Machined Laps

All the leading pipe fabrication shops are prepared to upset the pipe sufficiently to make a lap with not less than full pipe thickness after machining the back and face. The variety of types and dimensions of joints compels the leading shops to carry a large stock of dies to enable them to comply with the specifications of different engineers.

Possibly this condition has been largely responsible for the methods recently adopted by several shops. These shops upset the end of the pipe into a lap of sufficient thickness to permit machining out material to form any type of joint that an engineer may choose. It is their contention that it is of more importance to machine out a good finished product than to standardize on any type of lap.

Some engineers prefer a tongue-and-groove joint, using a flat metallic ring gasket instead of the weld seal or Sargol joint. The heavy-upset method also lends itself to machining out various forms of tongue-and-groove joints.

The use of heat-treated alloy steel studs threaded full length is now advocated by practically all engineers and manufacturers. Considerable research work has been done to determine the safe working limits of alloy steel bolting material when subjected to high temperatures. Some of this work has indicated that a bolt threaded its full length is slightly more elastic than a bolt threaded only at the ends.

Joints shown in the illustrations have proved that they are good for the service intended, and it is probable that, in line with the tendency of the times, the best features

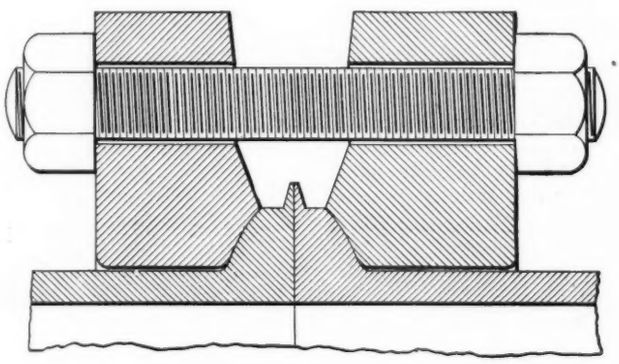


Fig. 3—New joint with more metal in the heel of the lap and a spherical seat for the flange

of each design will be retained in a composite standard joint with dimensions varying only for the different pressures prevailing in present-day practice. Such a step would be welcomed by piping designers and manufacturers.

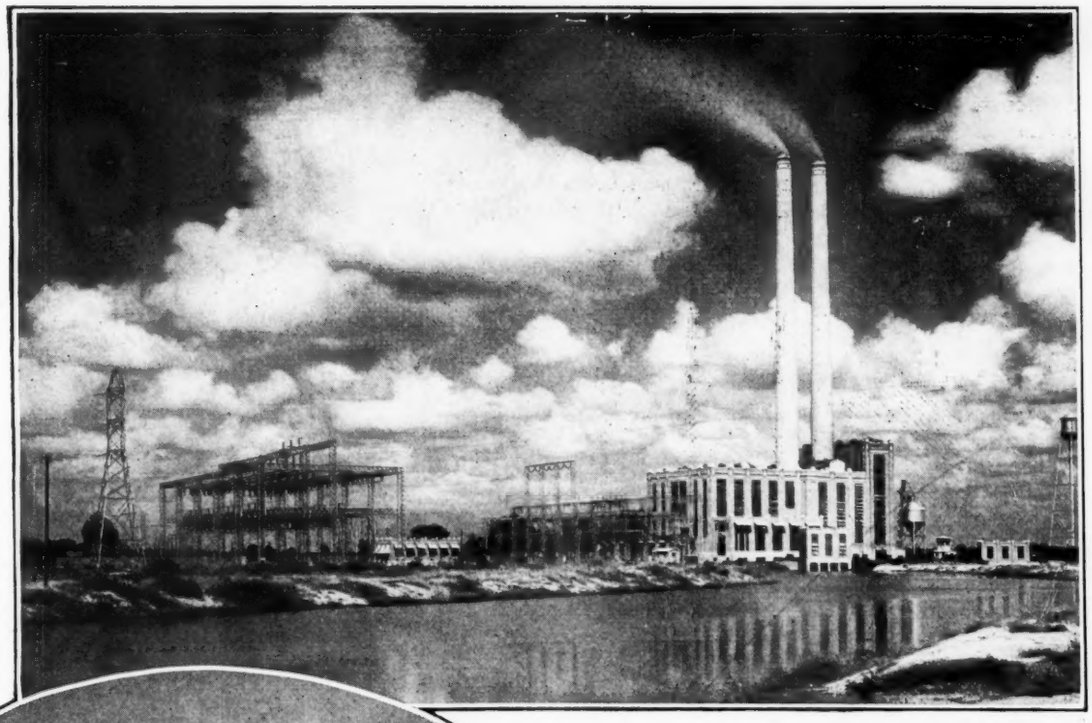
The Trinidad Lignite Burning Plant

ON THE opposite page are shown three views of the Trinidad, Texas, plant of the Texas Power & Light Company.

This plant was built close to a lignite coal field and far distant from any center of electrical consumption. For cooling water an artificial lake was constructed, the water being pumped from the Trinity River. About this lake are grouped the engineers' homes.

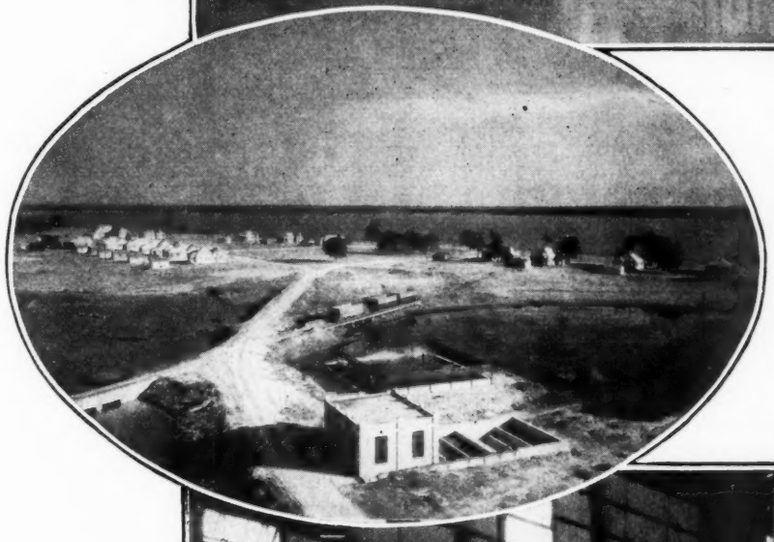
This plant burns lignite in the pulverized form. As discussed in an article in *Power*, March 6, the moisture content after pulverization varies from 30 per cent upward.

This plant operates on a base load, and owing to the low cost of the lignite as compared to more expensive coals, the cost per kilowatt-hour at the switchboard is as low as in central stations having greater thermal efficiencies.

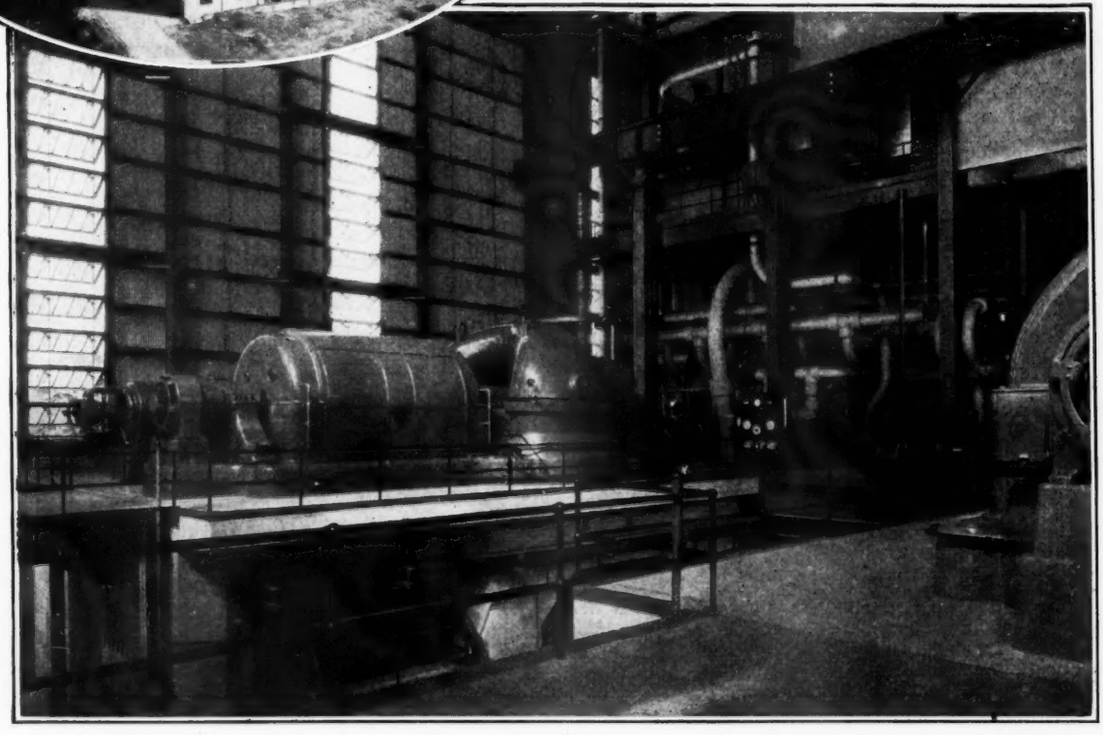


The 40,000 Kva. Plant

Trinidad Plant of Texas P & L Co. Burns Lignite



Left—Lake and Employees Town
Below—One of the 20,000 Kva. Units



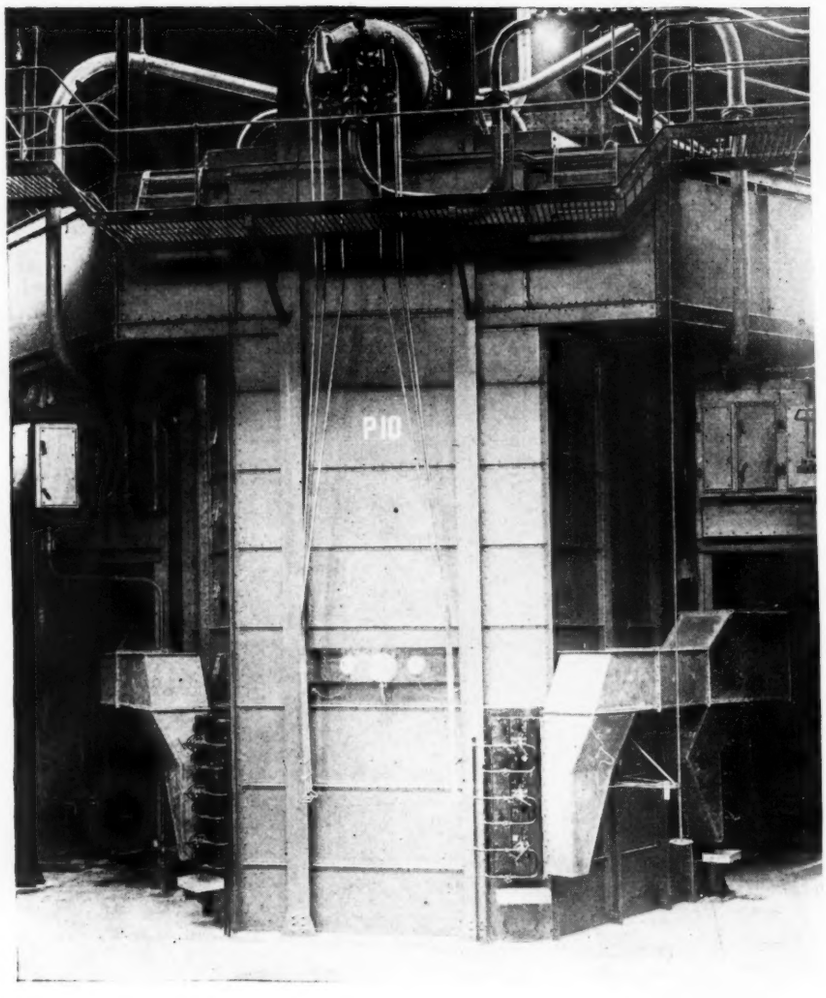


Fig. 1—A new Swedish oil-fired boiler

Sweden Produces a New Steam Generator

BY N. FARSSELAD

IN Västerås Power Station, acting as a reserve steam plant on the system of the Royal Board of Waterfalls, Sweden, two steam generators of a new design have recently been put into operation. The boilers are constructed by the former chief of the station, N. Forssblad, who is now technical chief of the Electricity Works of Stockholm, Sweden.

The first boiler, Fig. 1, is adapted for oil firing and was started in March, 1927. The second boiler is arranged for pulverized-coal firing and was put into operation in April of this year. A cross-section of this unit is shown in Fig. 2.

The new boiler, Fig. 2, may be described as an internally fired, single-drum sectional unit. The combustion chamber is surrounded by six sections, each consisting of upper and lower headers connected by 4-in. straight tubes. The upper headers are connected to a horizontal cylindrical drum at the top of the boiler, while the lower headers are connected to a short vertical drum at the bottom. Between the upper and lower drums a 16-in. connector is arranged, which runs through the center of the furnace and is protected by firebrick. For high pressures, for which the construction seems to be particularly suited, this 16-in. connector may be replaced by a number of ordinary tubes.

Burners are fixed at the six lower corners of the furnace and produce a flame around the connector in the center, which acts as an ignition arch.

The gases, escaping at the upper ends of the sections, pass downward through two superheaters in parallel in the oil-fired unit or through a superheater at one side and an economizer at the other side in case of the second unit, thence upward through an air heater to the fans and chimney. The air heater is recuperative and is specially designed for high-temperature working. It is partly built up from sheets of stainless steel and heats the combustion air of the oil-fired boiler to a temperature of about 1,100 deg. F.

It will be clear from the description, that the furnace is entirely surrounded by heating surface, and that there is no additional heating surface outside the furnace. The unit is to be regarded as a recuperative steam furnace with economizers arranged between the furnace and the recuperator. It would, however, be easy to put in some additional heating surface beyond the furnace if it were required.

The actual heating surface of the steam-raising tubes of the oil-fired boiler is 2,350 sq.ft., and the evaporation from cold water to steam of 280 lb. pressure and 800 deg. F. is 88,000 lb. per hour, or 37.5 lb. per sq.ft. The boiler is capable of raising steam very rapidly, and full pressure can easily be obtained from the cold state in eleven to twelve minutes.

The evaporation of the second boiler is not exactly known. It is, however, estimated to at least 100,000 lb. from cold water. The heating surface of that boiler is 2,400 square feet.

The efficiency of the first unit is about 75 per cent, but that of the second unit should be higher, owing to the installation of an economizer. In both cases a high effi-

ciency is not essential in comparison with high overload capacity and low first cost, as the plant is running only a small part of the year. The capital cost, as well as the space occupied by the new units, is only one-half compared with the previous water-tube boilers in the station, if the evaporation is taken as a basis.

The pulverized-coal mills are arranged for direct firing and for drying the coal by means of hot air from the air heater belonging to the boiler.

This design once again calls attention to the fact that large furnace volumes are not so essential to good boiler efficiency as so many assume. By reason of the small furnace the heating surface per cubic foot of room volume is higher than is customary. The cost of construction should not be excessive, for the headers can be made cheaply and the straight tubes make assembly cost low. When pulverized coal is used, the shape of the furnace is such that gravity assists in holding the particles in the furnace until consumed.

For peak-load service this boiler is especially suited, and the arrangement of twin pulverizers permits the coal grinding to be regulated to accommodate the load, without a decrease in fineness of grinding.

Contrary to what one might expect, the central pipe does not absorb heat to the point where its downward circulation is interfered with.

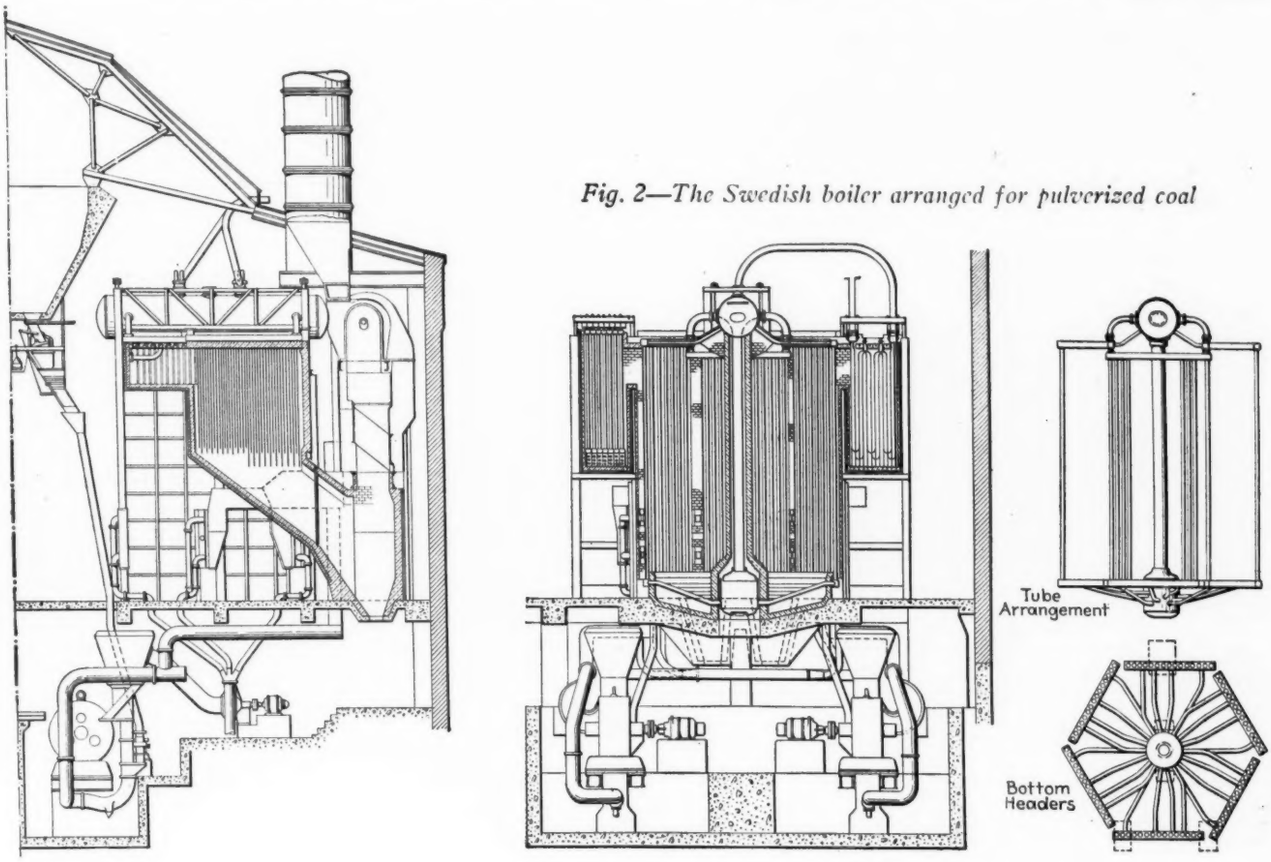
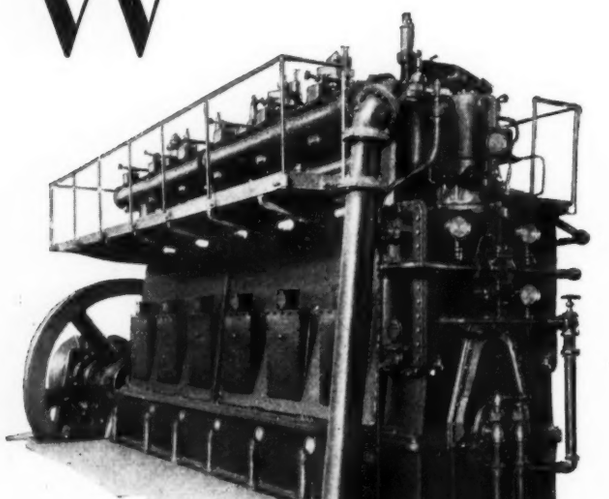


Fig. 2—The Swedish boiler arranged for pulverized coal

Sugar Cost Goes Down With Pressure

AN ENGINEER remarked the other day that the biggest waste in industry was the use of high-pressure process steam when steam at a low pressure would be equally satisfactory. He claimed that, as a result of this lack of engineering perception, many plants use live steam for processing and buy power. He cited a sugar refinery as doing just that thing. Yet sugar refineries operate on a small margin of profit and can ill afford to waste in any form. The June 19 issue will carry the story of a Southern sugar refinery where 90-lb. steam was abandoned outside power cut off and all the energy needed generated from the steam on its way to the process work.

WRITING SPECIFICATIONS *for a* DIESEL PLANT



By V. A. Stout
Consulting Engineer, San Francisco, Calif.

WHEN planning a Diesel plant, many fail to include in the specifications all the accessories needed. In a previous article in *Power*, May 22, I gave a list of the equipment needed for each engine, and in this present one will list the accessories pertaining to the entire plant.

A Diesel engine will require from six to eight gallons of cooling water under 80 deg. F. per brake-horsepower-hour, and if the temperature runs much over this figure, as it does where spray ponds or cooling towers must be used, fifteen gallons per hour per brake-horsepower should be figured on. With a 600-hp. engine this will amount to 150 gal. per min. of water, an item of operating expense of no mean proportions, particularly when it is allowed to run into the sewer. Put the power plant in the desert sections of the West, or where the cooling water is not only alkaline but scarce, and the situation is badly aggravated. These conditions call for circulating-water treatment, its reclamation, and cooling for re-use, which the manufacturer's single pump, as normally furnished, will not touch. In fact, that pump should rarely, if ever, be used for circulating the cooling water directly through the engine.

The Diesel cooling system, reduced to its simplest form, takes the following shape: A tank, good for at least ten hours' operating supply, is elevated about 25 ft. above the water intake to the engine. Around the bottom of the tank supports a concrete tank can be built, into which the water from the engine will overflow, to be elevated to the tank by the so-called "circulating water pump" of the manufacturer. When treated or scarce, the water can flow over a series of splash plates built into the tower structure, which then combines the functions of the tank support and a cooling tower. In small engine installations in arid sections of the country, chicken-wire netting over which the water trickles as it leaves the engine, cheaply and effectively takes the place of the splash plates.

In the larger plants, under similar conditions of treated water or scarce good water, spray ponds or cooling towers become a necessity. With such installations duplicate circulating-water pumps and possibly one or more additional pressure pumps for elevating the water to the tower or spraying it through the nozzles are required. A careful check should be made of the height of the cooling-water discharge from the engine and its relationship to the pressure required to spray the water properly from the nozzles. Sometimes, by a little planning and utilization of the pressure from the overflow an additional pump can be eliminated from the system.

With a cooling tower the water, after leaving the engine, flows to a sump from which it must be elevated to the top of the tower by a pump. After flowing down over the splash plates, it collects in a sump at the bottom of the tower, whence it must again be pumped to the engine cooling system. Here about 25-lb. pressure must be allowed for, so as to overcome the friction through the jackets and the various connections and to give the water adequate velocity. In all cases centrifugal circulating-water pumps taking their suction from the spray pond or the sump of the cooling tower,

DO YOU KNOW what extras you need when building a Diesel plant and how to list these parts? The author tells what to put in and why. See *Power* May 22, for the first article, giving a list of engine accessories.

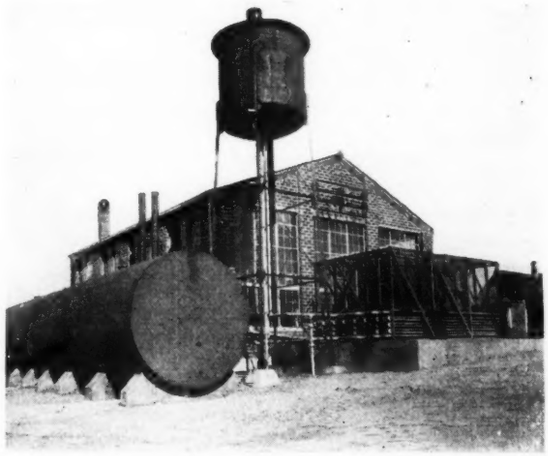


Fig. 1—A neat arrangement of oil tank, water tank and closed cooling system

must be self-priming, to assure water going to the engine under all conditions. A suction head of eight to ten feet is the best guarantee of this.

In the small engine installation a barrel of lubricating oil set up on wooden horses so as to facilitate draining the oil, is satisfactory. As the size of the power station increases, tanks and transfer pumps become necessary. A concrete lubricating oil tank in the basement is ideal, and a hand transfer pump meets the requirements of the case.

Tanks Should Be Conveniently Located

Tanks for fuel oil should be convenient to the power house and the railroad siding. In the interest of the economical purchase of fuel oil these tanks should hold a minimum carload of oil—namely, 6,500 gal.—and enough extra to carry the plant for at least one week's constant operation. A cylindrical tank, 8 ft. in diameter by 20 ft. long will hold about 200 bbl., or 8,400 gal. This is the best size of tank for the small plant, while the big plant should go to tanks holding from 15,000 to 50,000 gal., using their superior purchasing power to buy oil and store it when the price is low. The small tank will weigh from 6,000 to 7,500 lb., depending on whether the shell is $\frac{3}{16}$- or $\frac{1}{4}$-in. steel plate. All girth seams should be single-riveted and the longitudinal seams double-riveted with $\frac{1}{2}$-in. rivets. Such a tank can be erected complete for not to exceed $500.

Concrete tanks are quite desirable and much cheaper in first cost. The bottom of a concrete tank must be well reinforced with steel rods or hog wire. The vertical walls should have $\frac{5}{8}$- to $\frac{3}{4}$-in. reinforcing rods spaced eight to twelve inches. In every case it is desirable to set the tank so that the oil will flow by gravity through the fuel-oil centrifuge to the transfer pump. The intake should be piped with a steam or hot-water coil, to insure free flowing oil under all conditions of viscosity or weather.

Every Diesel installation where the individual parts of the engine are of such size that they cannot be handled easily by one man, should have an overhead crane, as shown in Fig. 2. This may range from a chain block hung on an extra-heavy rafter in the small plant, to a twelve-ton electric crane for the large plants. If the craneway is built into the building at the start and the crane installed, its first cost will almost be saved in the reduction in both time and labor when the engine is being erected.

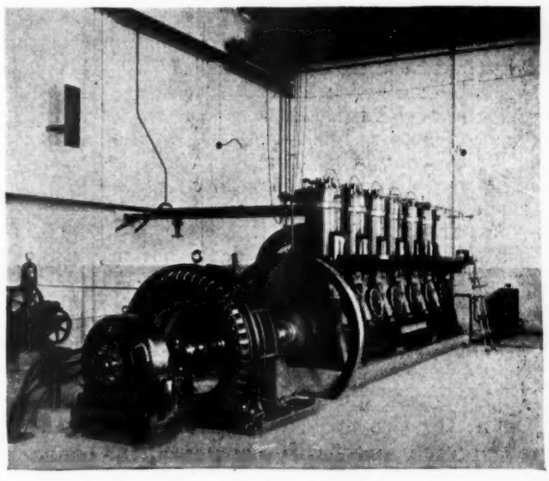
A modern station should have a fuel-oil centrifuge. For a 600-hp. engine the installation may run as high as $2,500, and the minimum figure will not be much below $1,000, even for the small plant. Such a centrifuge will clean the oil of all water and basic sediment. Wear on fuel-injection nozzles, piston rings and cylinder liners is materially reduced by treating the oil in this way before burning it in the engine. In the case of solid-injection engines, its installation cost is fully warranted by the fact that cheaper oils can be burned without danger of cuting out the injection-nozzle openings. In a case that recently came to my attention, before the centrifuge was installed a spray nozzle was good for only 24 hours of operation.

Re-use of Centrifugal Oil Limited

It is easier to induce a power-plant owner to install a lubricating oil centrifuge in the power station, since so many automobile engine manufacturers have installed and advertised lubricating-oil reclamation. However, there is a limit to the number of times a lubricating oil can be centrifuged and re-used. Eventually, the colloidal carbon, which the centrifuge cannot fully eliminate, builds up to a point where the oil has to be scrapped. This is not the case where clarifying and settling tanks are used for lubricating-oil reclamation. In this latter system three tanks are used—one for receiving the oil from the engine lubricating system, the second for mixing alum into the oil to coagulate the carbon and foreign matter, and a third tank for receiving the purified oil as it is siphoned from the second tank. This last tank acts as a storage for the oil ready to go into the engine system again. For a complete installation capable of treating up to ten barrels of oil in a batch, the cost of the apparatus may run as high as $3,000. But in the small plant, by using empty oil barrels for the containers, the cost may be kept as low as $50. These figures are to be compared with costs ranging from $500 to $2,500 for a centrifuge.

If we are going to centrifuge the fuel oil to protect the piston rings and cylinder liners from the wear of the foreign matter contained in it, how much more important it is to clean the air of dust particles, which in some sections of the country are a real menace. This can be done by air filters of the impingement or positive filtration type, centrifugal cleaners or air washers. The investment cost of air washers is the greatest, varying from $800 for an apparatus handling 4,000 cu.ft. per min.,

Fig. 2—An overhead traveling crane is always useful



up to $8,000 for a 25,000-cu ft. unit. Its one great advantage is that it is 100 per cent effective all the time.

Centrifugal cleaners are simple and automatic and for these reasons appeal to the operator. Their complete effectiveness is yet to be demonstrated, however. The positive filter, despite the fact that its effective work decreases the longer it is kept in service without cleaning,

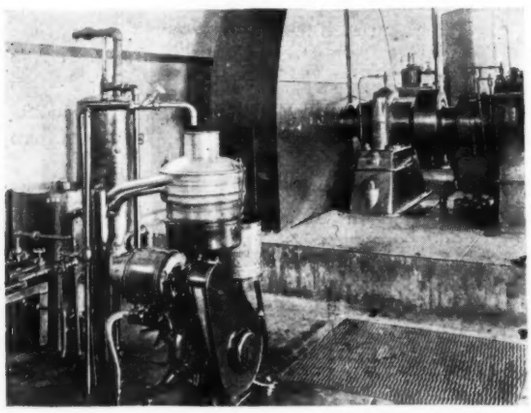


Fig. 3—An oil-filtering system in a pumping station

is the best. A good air filter for a 600-hp. engine, complete with two spare cells and a washing tank, costs less than $300. This low cost, coupled with the saving effected on wear of working parts of the engine, makes it a profitable investment.

The following data and equipment to be supplied with the engine are not claimed to be complete in any sense of the word. They are offered merely as a skeleton outline to be used as a basis for specifications as complete and elaborate as the purchaser may desire to issue.

Each engine manufacturer should be required to submit the following data with his bid:

Type and design of engine, including number of cylinders and stroke cycle on which the engine operates.
Bore.
Stroke.
Revolutions per minute.
Brake-horsepower, sea-level rating.
Brake mean effective pressure on which the engine is rated.
Compression pressure.
Piston speed, feet per minute.
Flywheel weight.
Flywheel diameter.
Net weight of complete engine.
Weight of heaviest piece to be handled.
Cubic yards of concrete for foundations.
Length of connecting rod between centers.
Fuel-oil consumption based on 18,500 B.t.u. oil at 50, 75, and 100 per cent of full load.
Main bearing, diameter and length.
Crankpin, diameter and length.
Wristpin, diameter and length.
Lubricating oil consumption, brake-horsepower-hours per gallon.

The engine builder should be asked to give the sea-level rating of his engine, based on a brake mean effective pressure not to exceed 85 lb. per sq.in. and a piston speed of 900 ft. per min. for four-stroke-cycle engines; 45 lb. and 900 ft. for two-stroke-cycle engines with uncooled pistons and 65 lb. and 900 ft. per min. if the pistons are either oil- or water-cooled. For engines exceeding these limits bids should be evaluated on a horsepower basis, refigured to conform to them. For engines whose ratings are based on figures less than those stated, credit should be given for their conservative ratings without refiguring their horsepower.

The builder should be required to guarantee the engine to be free from noticeable critical speeds in the crankshaft in a range 20 r.p.m. above to 20 r.p.m. below the normal operating speed upon which the horsepower is based.

The governor should be Massy, Jahns or equivalent, and the speed fluctuation from full load to no load should not exceed 3 per cent.

Each engine should be equipped with force-feed lubricating system of the flood type, furnished complete with oil cooler, oil filter, sump tank, and force-feed pump driven from the engine or independently driven provided its operation is assured under all conditions of engine operation. The lubricating system under force-feed lubrication must include the main bearings, crank bearings, wristpin bearings and outboard bearings.

The pistons of four-stroke-cycle engines of approximately 150 hp. per cylinder and the pistons of two-stroke-cycle engines under 100 hp. may be air cooled. But above these limits the pistons of both types of engines should be oil or water cooled.

The engine manufacturer should be required to furnish with each engine: Extension shaft with inboard and outboard bearings; couplings and keys all arranged for direct connecting the generator and exciter to the engine crankshaft.

A circulating water pump of ample capacity to handle the equivalent of 10 gal. per hour per engine horsepower,

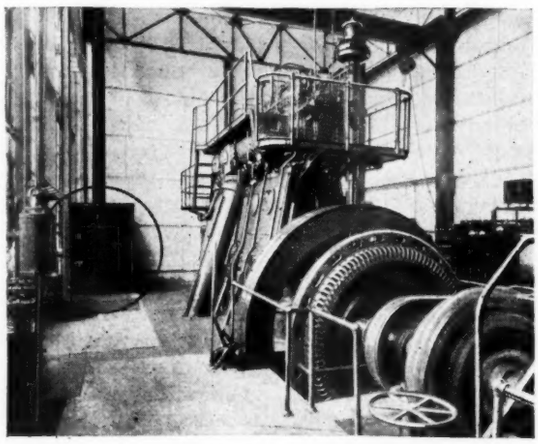


Fig. 4—An air filter on a two-stroke-cycle Diesel

15 gal. if cooling tower or spray pond, is required, and capable of pumping against a total dynamic head of 60 ft., is another item on the list. The pump should be motor-driven and mounted on common cast-iron bedplate with the motor. As an alternate this circulating water pump may be a reciprocating pump driven from the engine.

A fuel-oil transfer pump of the rotary or gear type, internally lubricated and motor-driven, should be furnished, having a capacity of 25 gal. per hour against a pressure of 25 lb. per sq.in., pump and motor to be mounted on common cast-iron bedplate.

Still another auxiliary to be supplied by the builder is an oil-heating system, drawing hot water from the exhaust manifold and through the coils in the exhaust

muffler, consisting of auxiliary oil tank, switch valve, jacketed day tank, oil lines, and fuel-oil pump, with recirculating hot-water pump. All this should be guaranteed to insure the satisfactory operation of the engine on any oil of the United States or Mexico exceeding 16 deg. Baumé specific gravity.

An exhaust muffler or silencer is necessary. Each

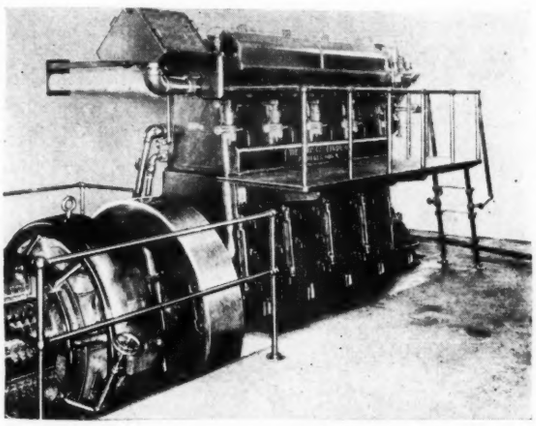


Fig. 5—A small four-stroke-cycle engine with air filter

muffler should be equipped with heating coils and provided with a clean-out door.

A complete set of station tools including spare engine parts, barring devices, special wrenches, gages, etc., shall be required from the engine builders and should be listed in the specifications.

An indicator reducing motion of an approved and satisfactory design shall be placed on each working cylinder of the engine.

For air-injection engines, at least one injection-air bottle and one air-starting tank is necessary for each engine. For mechanical-injection engines one starting-air tank only need be furnished. Each bidder should be asked to specify if the air-starting system for his engine is low-pressure or high-pressure, and in either case he should supply a kerosene-engine-driven air-compressor set of sufficient capacity to pump up the starting air in not less than 15 minutes.

The manufacturer should furnish air-starting valves and the necessary mechanism for air starting with each cylinder of the engine, and it is advisable that each cylinder of the engine be provided with a safety relief valve.

A satisfactory method of making any cylinder of the engine inoperative, should be provided, and there should be special provision to permit the fuel-oil lines from the oil pump to each cylinder injection nozzle to be primed by hand.

Pyrometer equipment is needed to show the temperature of the exhaust gases, so arranged that the exhaust gases from each cylinder can be tested separately. This will require one indicating instrument unit, as many points on the selector switch, and as many thermocouples as there are cylinders on the engine, along with the necessary lead wire. The indicating instrument should be calibrated to read from 0 to 1,400 deg. F.

An electrical revolution indicator is another desirable piece of equipment.

The engine will need gages for the cooling-water pressure, lubricating-oil pressure, air-starting pressure, fuel-injection system and wherever else the manufacturer may deem it essential.

Thermometers should be provided for each cylinder and one extra, and the cooling water overflow from each cylinder should be so arranged that thermometer wells are provided for in the cooling-water line of each cylinder.

As a final requirement of the specifications the builder should be required to place each engine under the following shop tests before leaving the factory: Two hours at rated speed with no load; three hours at rated speed with 25 per cent load; four hours at rated speed with 50 per cent load; five hours at rated speed with 75 per cent load; five hours at rated speed with 100 per cent load; and two hours at rated speed with 110 per cent load.

Handling Pistons of Oil Engines

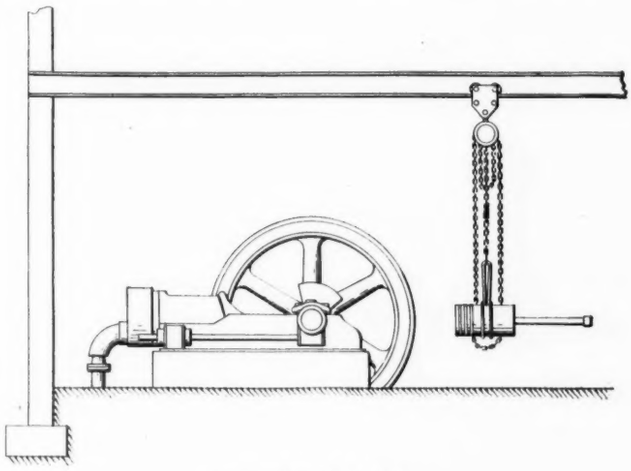
By H. Weiland Los

THERE are a few points worth considering when pulling the piston of a horizontal oil engine.

Before withdrawing the piston, it is a good plan to turn the crankshaft until the counterweights are vertical and as far as possible from the cylinder liner.

After the rod is uncoupled from the crankpin, the piston is turned 90 deg. so that the piston pin is vertical. This eliminates the necessity of supporting the connecting rod inside the piston by wooden blocks or wedges. Now the piston is hooked to the tackle by means of a rope strap and slipped out of the cylinder.

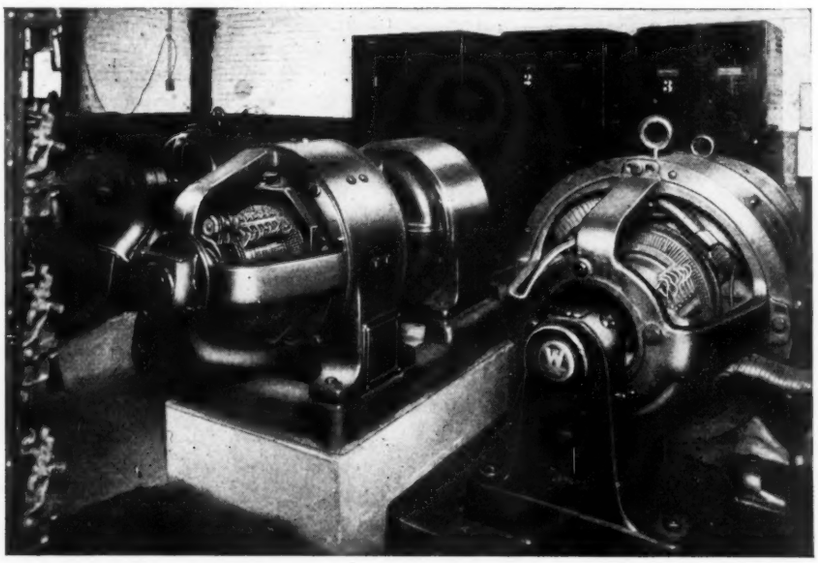
If the pin fits very tightly in the bore of the piston, it is advisable to remove the rings in order to prevent them from being broken. The piston and rod are placed



Removing the piston

upright on the floor and supported by means of the tackle, so that one man can hold the pin driver with both hands while another handles the sledge.

When reassembling the piston and connecting rod, the pin can be inserted easily if the piston is laid horizontally on the engine-room floor. The connecting rod is then shifted until the holes in the piston and small end of the rod are matching. In this way it will take but a few seconds to shift the rod to the required position. After the pin is slipped into the piston, the latter, with the rod, is again placed in a vertical position, and entirely assembled.



How to Determine

WIRE AND CONDUIT SIZES

for D.-C. Motor Circuits

By J. Elmer Housley

ELECTRICAL handbooks and many catalogs give the resistance of conductors and their current-carrying capacity allowed by the National Electric Code. These values of current work satisfactorily for short distances, but where the conductors are long the current allowed by the Code may cause an excessive voltage drop. In such cases the size of the conductors must be calculated. How these calculations are made will be shown by an actual problem.

In this problem, the layout consists of a run from a power house to a mill building 600 ft. away and to a pumphouse 500 ft. distant. The generating units are rated at 150 and 100 kw. respectively, and their voltage is 220 volts, two-wire. The mill motors comprise a 50-hp. series-wound hoist motor operating at full load one minute out of every four; two 5-, two 10-, one 15-, and one 25-hp. compound-wound motors. The pump motor is a 55-hp. compound-wound machine. All motors are designed for 220 volts. Tabulated, the load is as shown in Table I.

Several general factors were observed before calculating the size of conductor for the feeders. We considered the relative importance of various drives and the grouping of drives. The pumphouse was of first importance, with the hoist motor ranking next. The motors inside the mill building constituted a third group. Furthermore, each group could be operated to a limited extent without depending on any other group, a condition that indicated that three circuits should be individually controlled or run from the power house.

From previous work a general idea was developed that the individual wires of any circuit should be less than 500,000 circ.mils, even if circuits must be run in parallel. This was because light crossarm construction on the poles outside the plant was desired and only a small inexperienced line crew was available.

TABLE I—MOTOR HORSEPOWER AND FULL-LOAD CURRENT

Hp.	Amperes	Hp.	Amperes
1–50	192	1–10	40
1–25	96	1– 5	22
1–15	59	1– 5	22
1–10	40	1–55	210

In order to calculate the size of conductor, the full-load amperes of the circuit must be known and the per cent voltage drop to be allowed in the circuit must be stated. In the case of the pumphouse the feeder supplies only one

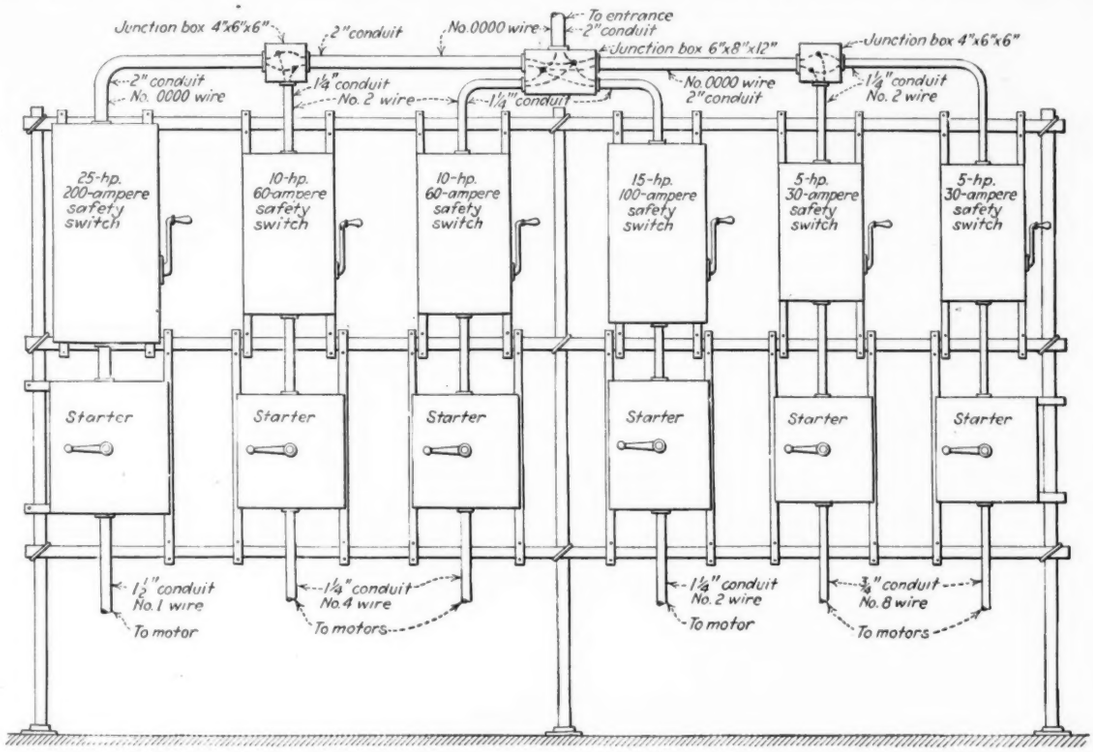
motor rated at 210 amperes. To this must be added 10 per cent to take care of the code requirements, which makes the current that the size of wire must be based on equal 210 + 21 = 231 amperes. By referring to a wire table it will be found that for 231 amperes a conductor of size 0000 or larger will be required for class *C* insulation conductors used when installed in the open, as in this case.

Five per cent voltage drop in a 220-volt feeder is considered the upper limit for good practice. Motors will normaily stand 10 per cent over or under voltage without serious damage, but low voltages tend to cause armatures to roast out, especially in the case of series motors. Fluctuation of voltage at the end of a feeder having a variable load, changes the speed of the connected motors and may affect the output of the plant. It is hardly necessary to discuss the economic theory of balancing the cost of the line against the cost of the energy lost, since the

The size of wire may also be obtained from the formula, *Circular mils* $= \frac{21.5\,IL}{E_d}$, where L equals the length of the feeder one way. Then the size of the wire in circular mils $= \frac{21.5 \times 210 \times 500}{11} = 205{,}200$. A No. 0000 wire has a cross-sectional area of 211,600, therefore meets the requirements for the feeder.

The hoist motor requires a feeder to carry 192 amperes, and as this motor is practically the same size as the pump motor, a No. 0000 feeder will be used for both machines. A little more copper in the hoist motor feeder will be a good investment, since in case of heavy loads the voltage drop will not be excessive.

The mill group of motors consists of six, having a connected load of 70 hp. and a full load of 279 amperes. In a group of motors we recognize the fact that every motor will not be loaded to capacity at any given instant, and the relation of the average load to the connected load is termed the diversity factor. Experience and test data



General arrangement of switches and starters and their wiring

per cent voltage drop more often settles this problem for a mill.

If we assume a 5 per cent voltage loss, at 220 volts this equals $220 \times 0.05 = 11$ volts. The length of the pumphouse feeder is 500 ft., or 1,000 ft. of wire. The allowable resistance of the conductors based on the voltage drop is determined by the formula $R = \frac{E_d}{I}$, where R is the ohms resistance of the two conductors in series, E_d the volts drop and I the full-load current in amperes. In this problem $R = \frac{11}{110} = 0.052$ ohm. Referring to a table of wire resistance, it will be found that a No. 0000 wire has a resistance of 0.049 ohm and may be used for the pumphouse feeder.

of similar drives help determine this factor. The method of operating the plant may give a clue. A batch of material goes through a grinder, then up an elevator and through a washer, from which is is seen that the peak load on each machine comes one after the other. Certain machines may be started and shut down in succession, as in a machine shop. In the mill we estimated that the ratio of the average load to the connected load was 70 to 75 per cent, therefore it would be expected that the load in the feeder would not exceed about $279 \times 0.70 = 195$ amperes. The feeder is 600 ft. long, or 1,200 ft. of wire. This works out so that a No. 0000 wire can also be used for this feeder.

It so happens that all circuits may be constructed of No. 0000 cable. The two circuits to the main mill could be paralleled with some advantage, but the advantage of

testing circuits for grounds at the power house and uniform size of switches and fuses was held to justify separate circuits. Each circuit at the power house was provided with a 400-ampere switch and it was fused for 300 amperes, although the switch has clips for as high as 400-ampere fuses. The feeders have a rating of 325 amperes and should not be fused higher than this value.

The group of six motors in the mill were fed from a distribution panel which served as a building entrance switch and in this case controlled a single incoming feeder and single building feeder to the motor control group. The panel has a 400-ampere, two-pole, fused, externally operated safety switch and was located near the building entrance of the feeder into the building. This panel protects the building circuits and is the first line of defense against short circuits in the mill wiring and is usually fused lower than the power-house switchboard protection. In the mill the wiring was run in conduit, so that rubber-covered wire had to be used. A No. 0000 rubber-covered wire can be fused for 225 amperes, which size was used in the entrance switch.

The choice of a safety switch or an inclosed direct-current circuit breaker for distribution or motor control is dictated by economic reasons alone, assuming that no unusual plant conditions are encountered. In this case a shutdown sufficiently long to replace a fuse would not cause any appreciable loss of output.

A No. 0000 double-braid, rubber-insulated, stranded, two-conductor feeder in two-inch conduit was run between the distribution switch and the motor control group. A double-braid covering is required by the Code for conductors larger than No. 8; stranded conductors are required for No. 6 size and above.

TABLE II.—SWITCH, FUSE, WIRE AND CONDUIT SIZES SELECTED

Motors Size, Hp.	Full-Load Amperes	Switch Size, Amp.	Fuses Size, Amp.	Armature Wire, Size	Field Wire, Size	Conduit Size, In.
25	96	200	120	No. 1	14	1¼
15	59	100	75	No. 2	14	1¼
10	40	60	50	No. 4	14	1¼
5	22	30	30	No. 8	14	¾

Each motor circuit was supplied with a fused safety-type switch, and each switch was tapped into a junction or splice box on the feeder conduit, as shown in the diagram. The size of wire and conduit used in the junction-box connections are shown in the figure. The wire size is made to conform with the Code, which states that automatic overload protective devices may be omitted at the point where conductors carrying the current of only one motor are connected to the mains, provided their carrying capacity is at least one-third that of the mains, if the length of the conductors between the mains and the motor protective devices is not greater than 25 ft. and they are suitably protected from mechanical injury. The custom of running the feeder through the side top knockouts of the switchbox should be discouraged, as this makes it difficult to remove a switch for repairs. With a short conduit line into the top of the switch the hot lead terminals may be taped up and any switch changed in a few minutes. The inclosed starting box for each motor circuit was located directly under the safety switch and the motor leads were run in individual conduits to the motors, which were fairly closely grouped in the small mill building. The sizes of switches and circuits selected are given in Table II.

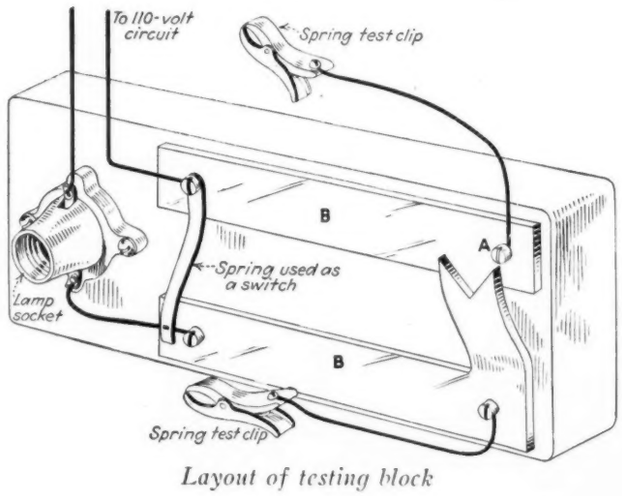
The National Electric Code specifies that fuses for continuous rated motors above two horsepower should be 125 per cent of the nameplate rating. These fuses can be used on wire having a carrying capacity of 110 per cent of the nameplate rating of the motor. For the first motor in Table II the full-load current is 96 amperes; 125 per cent of this is 120 amperes. The standard switch for a 120-ampere fuse is a 200-ampere, and any fuse from 101 to 200 amperes may be used in the fuse clips. In this case 120-ampere fuses were used. To allow the use of these fuses a wire of a capacity equal to $96 + 10 = 106$ amperes should be used. Reference to the wire table will show that the nearest size rubber-insulated conductor for this current is a No. 1. The field current of the motors is small, but the wire required for this circuit is a No. 14, because the Code specifies it as the minimum size to be used. Section 503 of the Code gives the size of conduit for a given number and size of wire, and the conduit sizes in the right-hand column of the table were taken from Code recommendations. The switch, fuse, wire and conduit sizes for the other motors were selected in the same way as explained for the 25-hp. machine.

Test Board Checks Fuses and Lamps Easily

By A. J. Zimmerman

TEST boards have been made in a multiplicity of forms, but the one shown in the figure I have found to be very convenient to have on a work bench, for testing lamps, fuses and small motors. The equipment is mounted on a piece of 1¼-in. marble. At one end is a receptacle for an incandescent lamp. This lamp is in series with the line which connects to two brass strips *B*. Two test leads with clips are connected to the brass strips.

Lamps and fuses are tested by placing them between the brass strips at *A*. Cartridge fuses are tested by placing them across the strips at *B* or between the clips on the test lead. For testing small motors at full voltage, the lamp is replaced by a fuse. When this is done, care must be exercised not to short-circuit the brass strips, or the fuse will be blown.



Layout of testing block

As a means of quickly checking the test lamp to make sure it is in good condition before making a test, I have connected a piece of spring brass to one end of one of the strips *B* as shown. By pressing the free end of this spring down, the two test bars are bridged and the lamp is connected directly across the line.

Electrical Applications

Control Panels Make Complete Paper-Machine Switchboard

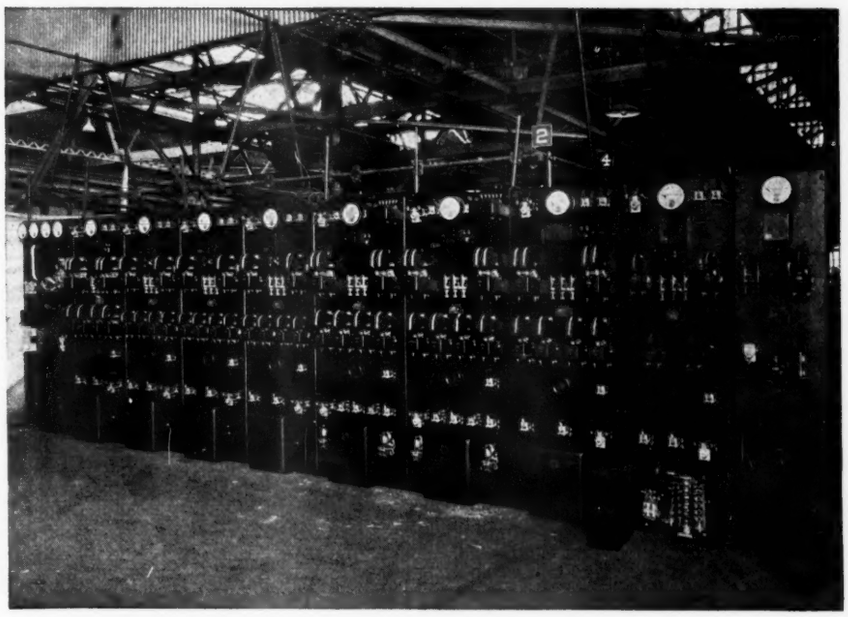


Fig. 1—Control panels for a modern paper machine arranged in a single group

MODERN paper machines have a direct-current motor to drive each section. The motor controls are so interconnected that the relative speeds of the sections of the machine are maintained to give the proper tension in the paper. The speed of the machine as a whole can be adjusted over wide ranges. As each machine may be made of eight or more sections requiring several hundred horsepower of motor capacity, and, where the source of power is alternating current, a motor-generator set is also required, the control for the power equipment becomes quite extensive. This control may be arranged in a complete switchboard.

The use of control panels to make up complete switchboard units is illustrated in Figs. 1 and 2, which show the control panels for a paper machine drive at the plant of the Great Northern Paper Company, Millinocket, Me. Each section of this switchboard might have been obtained from the manufacturer as a separate panel to be mounted whenever and wherever desired. Reading from left to right, in Fig. 1, the panels are for: Main generator control; control for suction couch; control for first press; control for second press; control for third press; control for first drier section; control for second drier section; control for calender; control for reel; and control for rewinder.

All these panels are for full-automatic operation with definite time acceleration and are wired for push-button control. All panels have compound bases mounted on angle-iron supports 90 in. high. The equipment is used with a Rice, Barton & Fales paper machine, which is driven by motors aggregating 735 hp. at normal ratings.

This system not only simplifies the transmission of power to the various sections of the machine, but also permits extremely accurate control. Some of the important advantages of this system of paper-machine drive and control include a large reduction in power over that required by the older methods; it allows an increase in the speed of the machine, since the speed regulation is so accurate the danger of breaking the paper is greatly minimized; and the cost of maintenance is reduced owing to the elimination of belts, gearing, clutches and shafting.

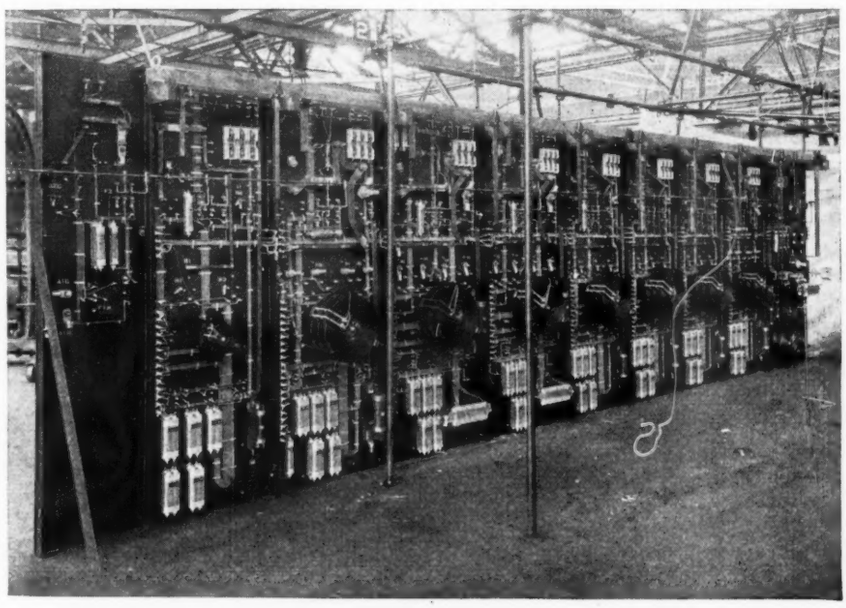


Fig. 2—Rear view, showing the wiring and control apparatus on the back of the ten-panel control board, Fig. 1. From this board a total normal rating of 735 hp. of motors is controlled. These panels are for the control of the main generator, the suction couch, three press and two drier sections, a calender, a reel and a rewinder

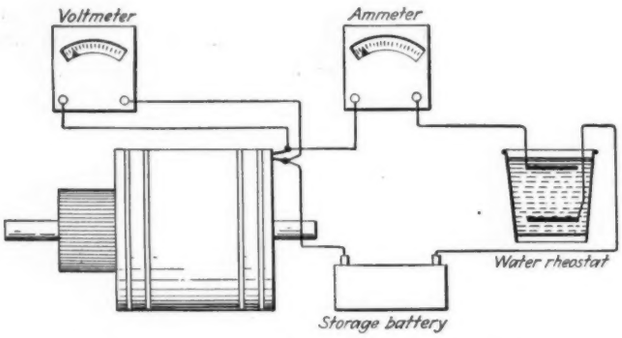
Photos by Courtesy of the General Electric Co.

IDEAS FROM PRACTICAL MEN

For the exchange of practical information and ingenious expedients in operation and maintenance of plant and equipment

High Resistance Caused Armature to Heat

ONE OF the bearings on a 140-kw. 110-volt direct-current generator burned out and allowed the armature to rub on the polepieces. As the winding was on the surface of the core, it was seriously damaged and had to be renewed. The winding consisted of square copper bars with involute end connectors. For the new winding the copper bars for the conductors were available in



Method used when measuring the resistance of the armature

stock, but the involute end connectors had to be made from strip copper. After rewinding, the armature was tested and everything was apparently in good condition.

When the machine was put into service, it operated at an excessive temperature when loaded. Another test of the winding failed to show any short circuits or other faults. It was then thought that the trouble was due to unbalanced voltages in the winding causing circulating currents to flow through the coils. To check this condition, two slip rings were placed on the shaft at the armature, the winding was opened up at one point and connected to the slip rings. An alternating-current ammeter was connected to the rings by two brushes. This arrangement placed the ammeter in series with all the coils on the armature. When the machine was started, any unbalance of the voltage would cause a current to flow through the ammeter. This test failed to show any electrical unbalance in the armature winding.

The resistance of the winding was then considered as a possible source of heating, and it was decided to measure the resistance. A 24-volt storage battery was available to supply current to the winding to obtain current and voltage reading for calculating the resistance. As no low-reading voltmeter was at hand, it was arranged to supply current into the back end of the winding so as to have all the coils in series. The battery was connected in series with the winding at the point where it had been previously opened, and the voltmeter and ammeter connected as shown in the figure. The current was adjusted to 50 amperes, at which value the voltmeter indicated about 10 volts. This indicated a winding resistance of $10 \div 50 = 0.2$ ohm, which was about four times what it was calculated to be.

An examination of the winding revealed the causes of the heating to be in the end connections, which were made of sheet copper. These were only about one-half the cross-section they should be. Furthermore, they were connected to the bars forming the winding, by cutting a slot in the end of the bars and soldering the connectors into the slot. New connections, twice the cross-section of the first ones, were made and these were provided with terminals that fitted around the ends of the armature conductors. This arrangement gave twice the contact area of the first method used. After the winding, the machine went into service without any further trouble.

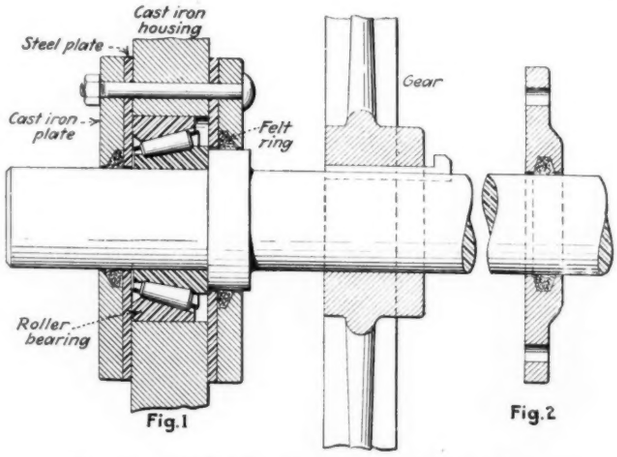
GEORGE RICHTER.

Moscow, U.S.S.R.

Improved Felt Retainer for Roller Bearings

NOT infrequently, the simplest way of making certain pieces of equipment, from the viewpoint of manufacture, is not always the best from the viewpoint of operation or maintenance in the field. Figs. 1 and 2 show two types of felt retainers for roller bearings. Fig. 2 shows the more common way of holding the felt ring at the end of the bearing, a felt ring being simply inserted in a groove in the bearing end.

The retainer shown in Fig. 1 is a more practical way of holding the ring. It is made in two pieces consisting



Figs. 1 and 2—Types of felt ring retainers

of a steel plate nearest the housing and a cast-iron plate bolted directly up against it. One of the important advantages of the method shown in Fig. 1 over that in Fig. 2, is that the felt is readily replaced without dismantling the bearing. With the construction shown in Fig. 1 the only thing necessary, when renewing the felt ring, is to loosen the bolts and push the cast-iron plates to one side, remove the old felt ring and insert a new one. It will be apparent that this can be readily done without removing the housing from the shaft as is necessary with the methods shown in Fig. 2.

B. W. BRONNER.

Auburn, Mass.

Fig. 1—How the brickwork was supported while the upper lintel was being put in place

Installing a New Flue in an Old Stack

IN CONNECTION with installing stokers under boilers in an old plant, it became necessary to provide additional flue area for the increased capacity required by the stokers. The old flues had passed out through the wall down into an underground passageway and into the base of a brick stack which was about 9 ft. in diameter and 125 ft. high. The old flues were so contracted in area and had so many turns that there was a big loss in draft between the stack and boiler connections.

A new flue was designed to come out of the top of the boilers and pass directly into the stack. The stack had been built about twenty years previous, and there were no drawings or data available as to the details of construction, but we assumed that it was built in the usual manner with an inside lining independent of the outside wall, which proved correct. The brickwork was cracked and the lower part, which was about 15 ft. square, had been tied together by a pair of channel irons on each side, pulled together by tierods and turnbuckles. The new flue was to be 5½ ft. wide by 13 ft. deep.

As the opening for installing the new lintels to support the brickwork above this opening would be equivalent to nearly one-half the width of the stack, it was not considered safe to cut out the brickwork without providing some means of supporting it. Also, as the stack was being used to maximum practical capacity, it would be impossible to cut any extensive opening into the inner flue without destroying the draft. We therefore made up two pairs of 12-in. I-beams about 4 ft. long bolted together with pipe separators and the two pairs of beams fastened together by two pieces of I-beams about 16 in. long so as to provide an opening through which the lintels could be inserted.

An opening was cut in the center of the stack and these I-beams were put through the opening, projecting through the inner section of the chimney so as to support the inner lining. The beams were thoroughly wedged into place and after the brickwork was set an opening about 8 ft. long was cut across the stack and 12-in. beams to form the lintel of the new opening were put into place and the ends properly wedged up on iron plates.

After this was done, the brickwork of the outside portion of the stack was taken out, the lower I-beams with the vertical pieces were removed, leaving the upper pair of beams bricked in above the lintel to form a support for the damper. After the opening had been cut to size, a section of the new flue, including the main damper, was installed in place, projecting through to the inner lining of the chimney, which had not been touched. The main damper was hung and was supported by three 4-in. diameter iron rings, these rings being supported by an eyebolt, which projected through a plate on the top of the pair of I-beams. By means of nuts and check nuts the damper could be raised so as to swing clear, the bottom being provided with a short shaft extending through a thimble in the bottom of the flue to act as a guide only.

After this work was done, a start was made to tear out the inner lining of the stack. Half of this was done at a time, and as the bricks were torn out from the bottom, the opening was boarded up, there not being sufficient heat to burn the wood at once. In this way the entire opening was cut through, being protected by boards until it was all done, and we never had a free opening into the stack more than three square feet in area, which did not cause serious trouble with the draft.

As the work progressed, the rest of the flue was bolted to the angle irons provided on the first section, and the entire system completed ready for service. When this work was all done, on a Sunday, when the load was light, the boards were knocked into the bottom of the stack and the main damper closed. Later, the system was put into service and we found that the loss in draft had been reduced over 50 per cent even with the increased capacity. The old flue opening was subsequently bricked up after a clean-out door had been installed, and the stack has been in successful service ever since.

CHARLES H. BIGELOW.
Plainfield, N. J.

Fig. 2—Damper in position in the new duct opening

COMMENTS FROM READERS

In which those who agree and those who disagree, with either authors or editors, are afforded an opportunity to express their views

Machinery and the Man

I HAVE read with much interest the editorials, "Let the Machine Do It," in the April 10 issue, and "How About the Man," in the May 1 issue, and Mr. Reiter's letter in the same number. The installation of motorized machines means the displacing of manual labor, and doubtless this causes considerable inconvenience in many individual cases. I have first-hand information concerning one plant where the number of employees was reduced over a term of years from 1,000 to 250 and the output of the manufactured product was increased enormously, with resulting benefit in greater profits for the manufacturer and lower prices to the purchaser.

This was accomplished mainly by the use of motorized material-handling devices and substituting machine operations for manual labor. Where did the 750 displaced employees go? In addition to getting employment in filling stations, barber shops and similar places, as suggested by your second editorial, I believe the situation was helped out by the number of new industries that are being created. There is no limit to what a man wants. Witness the automobile and the radio. Everybody wants one, and now the airplane is getting more and more common. Mr. Reiter's figures quoted from *Worlds Work* show a decrease of only 8½ per cent in the total number of workers from 1919 to 1925. If it were not for the fact that the newer industries are continually absorbing the workers displaced by machinery in the older industries, I am sure this percentage would be much greater. As long as people continue to want new and better things like automobiles, radios and flying machines, just so long will new industries be established to help absorb the workers displaced by machines in the older industries.

R. F. ROGERS.

Boston, Mass.

* * * *

Synchronous Motor Replaces Slip-Ring Type

AN ARTICLE by K. B. Spear in the May 15 issue, on "Dynamic Braking of Synchronous Motors," well describes the advantages of these motors for quick stopping. The author, however, should have gone further and explained the advantage they have in improving the power factor of the electrical system, especially when running at less than full load.

We have a 200-hp. motor of this type, rated at 0.80 leading power factor, which has 90.7 per cent efficiency at full load and 87.2 at half-load. This motor was installed to replace a 100-hp. slip-ring motor driving two rubber mills. The new motor is at present driving two larger mills and has sufficient capacity to handle a third. It gives smoother and quicker emergency stopping than we get on a 250-hp. slip-ring motor driving another line of mills in the same building.

The power factor of the power system has been raised from 65 per cent lagging to 88 per cent lagging, which saves enough on our power bill to pay for the motor in about one year. We are given a reduction on the demand charge from the power company in proportion as the power factor increases. After about ten months' operation of this equipment we are well satisfied that synchronous motors with dynamic braking have helped materially in reducing the power bills, and that they give practically trouble-free operation.

I might add that the first cost of the synchronous motor was lower than for a slip-ring motor and magnetic clutch and brake.

The old drawback of synchronous motors—low starting torque—seems to have been overcome with the new types, as we get almost as good starts with no greater starting current than with a slip-ring motor. Should it happen, however, that the motor is stopped with the mills loaded, it may not be able to start. By using the reversing switch and backing the rubber out of the rolls, we have had no further difficulty in starting.

J. J. WYNHOFF, Chief Electrician,
Racine, Wis. Chicago Rubber Clothing Co.

* * * *

Is Spare Equipment Worth the Cost

THE editorial in the May 1 issue, "Is Spare Equipment Worth the Cost," opens a subject for consideration that has in many cases been given far too little thought. I believe it is fair to assume that in 50 per cent of the industrial plants having an installed capacity of 1,000 kw. or over, at least 25 per cent of the fixed charge and operating labor are due to spare equipment. In fact, it will be found that the capacity factor in these plants is about 0.6 for 3,000 hours of the calendar year. For the remaining 4,760 hours the capacity factor will be from 0.2 to 0.3 and in some cases lower than this. This calls for an investment out of proportion to the productive service rendered by these plants and of course makes it impossible to show a high dollar efficiency.

In the period when a power plant was a necessity to every manufacturing establishment, regardless of cost, this problem did not come in for any great amount of interest, and the lack of study evidenced by modern practice is no doubt a "hangover" from that day. An examination of the reasons advanced for the spare equipment investment and continuous service required are pertinent:

First, there is the attitude on the part of production men that the power plant must stand ready at all times to deliver all the power and all the steam for process that they can conceivably require, at a moment's notice. When production men learn that a power plant is entitled to some time to prepare for a large change in load just as a manufacturing department requires time to tool up for a change of product, the cost of this kind of stand-by service will be reduced.

Another factor is a large investment for 24-hour service, when the service could be adequately supplied for 14 out of every 24 hours by equipment costing only a small part of that required for all-day service. The whole investment could be reduced on the order of one-third by

an interconnection of power stations, which would greatly reduce operating costs.

Night operation of the power plant is frequent for such services as light and power for overtime work, lights and elevator service for watchmen, and stand-by service for fire-fighting equipment. Where the service is required for power and light only, the obvious remedy is a public-utility connection, but in far too many cases the demand charge for such a connection is out of all proportion to the service rendered. The idea of paying the charge for a 1,000-kw. demand in order to obtain 100 kw. off-load service, 200 kw. fire-fighting service and 1,000-kw. emergency breakdown service, does not "set well" with the average management.

Where steam for heat and process is required, the public utility is not at present able to supply this, save in exceptional cases, at a figure worthy of consideration.

The obvious answer appears to be the interconnection of industrial plants for both steam and power service. There are a surprising number of cases in our industrial centers where one base-load industrial plant and several smaller peak-load plants could easily be interconnected. The saving in operating cost alone by the smaller plants during light-load periods would easily pay a fair return to the base-load plant. There is no doubt that spare equipment for emergency service and operation during light-load periods are the most serious factors the industrial plant has to contend with today.

Detroit, Mich. L. A. PIERSON.

* * * *

Hazards in Coal and Ash Handling

IN THESE days of strenuous efforts toward combustion efficiencies both with stoker firing and powdered-coal burning it is timely indeed to give some attention to the problems of coal and ash handling. The article by K. Rankin, in the May issue, as to the hazards incident to this work appears to be an interesting step in that direction.

Aside from the harmful fumes existing in poorly designed and ventilated ash basements and tunnels, his concern seems to center around the dangers due to the necessity of disengaging inactive coal and ash in track hoppers, coal bunkers, ash hoppers and ash tanks during the operation of the respective conveying apparatus, or even when the latter is not in use, but the possible avalanching of the material constitutes a menace to the men occupied with disengaging or trimming within these containers.

The regrettable accidents referred to by Mr. Rankin are typical and not at all exceptional. There are cases on record where men were trying to reclaim idle coal in some large overhead bunkers and were smothered to death by a sudden avalanche. In view of the fact that some designers are fully ignoring the "discharge efficiency" of these bunkers, as long as the cubical contents are there, and that particularly high volatile coals should not be permitted to remain idle, it is surprising that more accidents have not become known on this score.

The root of the trouble, in my opinion, lies in the design of the various bunkers, hoppers and tanks. There should be no need to enter any of these containers to free the material, even in freezing weather.

Of first importance in the design of any of these containers is the exclusion of acute corners in the vertical body and of sharp valley angles in the hopper bottom, as these are bound to retain some of the material. Calculations as to angles of repose often become useless, as the vertical component of the forces within the container increases and when the contents are wet or even moist. Furthermore, in case of run-of-mine bituminous coal and of ashes the intermixture of fines with lumps or clinkers creates a much more difficult condition—friction over practically the entire surface of the contents—than in case of uniformly sized anthracite to the detriment of free flow and to the theory of assumed repose.

Even in cylindrical containers, which are devoid of corners, arching and packing are usual as the material reaches the contracted area at the bottom. Breaking down such an arch through the discharge gate at the bottom with a rod or bar has caused accidents in the past and will do so in the future, unless an effective agitator shaft or the like be used from a safe position for the operator. Conveniently located access-doors or poke-holes are also helpful to some extent.

Whether the hot ashes are quenched for the benefit of the mechanical conveyor, or whether the condensation of the steam from a steam-jet conveyor moistens them, provision should be made for effectively thawing out ash tanks, and then with the assistance of agitators inducing a flow without the necessity of entering them. Perforated steam coils within the tank are ineffective and so is the steam jacketing of the hopper bottom. By far the most logical method is to inject steam at the discharge gate at the time the ash is to be discharged, so that there will be no time for the condensate to freeze.

The suggestions offered herein have been applied in a number of cases and have successfully eliminated such hazards as Mr. Rankin refers to.

EUGENE HAHN, Chief Engineer,
Philadelphia, Pa. Hahn Engineering Company.

* * * *

Post-College Training for Engineers

THE points brought out in the editorial on "Post-College Training for Engineers," which appeared in the Dec. 20, 1927, issue have come to my mind frequently since that time. This subject is both broad and important. In the past it has been left to the individual to add to his knowledge through his personal effort, through experience in his profession, through contact with other engineers, membership in engineering societies, and reading of periodicals.

His personal efforts are essential if he is to improve as he should, year after year. No matter how available may be sources of authentic information, they are useless without his effort to assimilate. His college training has been largely for the development of this power of assimilation, and the power to collect knowledge in the form of authoritative books and data and to utilize it correctly.

Experience in his profession may add to his education or not, and generally adds much, but not always in the way desired. After college the man may not be able to find the kind of an opening for which he has prepared himself. If post-college development is guided only by chance environment, he may never find his way into the exact field for which he has prepared himself in his engineering studies.

Contact with other engineers is a most important means of self-education, but has its limitations. Men wish to relax when they meet outside of business, and are much more likely to talk of sports and politics than of the intricate details of engineering problems. Then, again,

at this time of life the family demands an increasing proportion of a man's spare time, quite rightfully. The secrets of industry must be respected. Furthermore, it is not always possible to fall into the exact circle of men that one would wish.

Engineering societies offer a notable opportunity for mutual contact between engineers and are of prime importance in keeping an engineer up to date in his line, and in some cases this means of extending education is most effective. The publications of the society may give just what the individual needs to round out what he has learned and hopes to use. But the experience of many is that there is much for which he has no immediate use, and still he may some time need it, and the question comes, How can these data be made available when needed?

The reading of engineering periodicals, selected to fit the needs of the individual, is probably the most effective single means of extending an engineer's higher education. True, it is subject to the failings of the publications of engineering societies, that subject matter is diversified and only to a small extent fits the exact desires of each individual. But modern periodicals on engineering subjects are thorough in their treatment of their respective fields, and they are full of the latest information. Their field of usefulness cannot be replaced by any other agency.

With these means of extending education at hand, not forgetting public and engineering libraries and the book publishers, is there anything more that could be desired? To my mind, there is still something that might add materially, both to the amount of valuable information and to its availability or usefulness.

One great benefit of an education is to teach where to find information and how to use it. No engineer can carry all needed information in his head. So it becomes important that he be able to classify his data, and keep them so filed that he can always find what he wants.

The Dewey Decimal System, used almost universally in libraries, has much to commend it in arranging collected data, but it may be found that parts of this system have not been worked out in sufficient detail to serve certain purposes. This system should be extended, by representative engineering societies, to cover all necessary details of their respective subjects, thus completing this valuable tool.

Next, supposing this system to have been sufficiently developed, each subject of interest to a given engineering society will fit under a classification number. Papers read before the society may now be printed in booklet or pamphlet form and marked on the cover with the classification number. The member filing these according to the number, will then automatically place each paper with others dealing with the same subject.

This is only a beginning. A university service might be established whereby the new developments with respect to the various courses might be presented in pamphlet form, each given its classification number, so that the past student is kept posted with the latest information. This, of course, would cost something.

Would it not be possible to print engineering books with the proper classification number on the back? Articles of such a nature as to be of permanent value might also be printed in engineering magazines with the proper index number above the title.

I speak from experience when I say that it is no small task to gather all the data that are needed in a special line and keep them filed and indexed so that they are useful. Life is brief, at best, and much has to be done besides keeping up files. Now, why not put this on a manufacturing basis, and let the classification be done at the source, so that the time of each man may be conserved in deciding where it should go?

Is there not a fertile field for the improvement of methods of presenting engineering data through standardization? This subject has many angles, but it appears that the most important angle is that of the user of the data, who must find a way to preserve them for the moment when they are required, or otherwise lose nearly all of their value.

THOMAS M. GUNN.

Brooklyn, N. Y.

ANSWERS to "What Do You Know"

The questions are on page 1050

Ans. 1—The solubility of calcium carbonate in water decreases as the temperature is increased, consequently at the higher pressure more of the salt will be precipitated as scale.

Ans. 2—It is a receptacle attached to a condenser or an integral part of the latter, into which the water resulting from the condensation of the steam entering the condenser, passes, to be later withdrawn as boiler feed.

Ans. 3—At a given rate of coal consumption the flue-gas temperature will decrease at an increase in CO_2. Knowing the coal fired and the flue-gas temperature, the relative CO_2 as compared to the per cent obtained during the test can be ascertained.

Ans. 4—In a uniflow, as in case of all engines, the steam pressure on the piston becomes zero at the point when the expansion pressure in one cylinder end equals the compression pressure in the other end.

Ans. 5—The losses will range from 0.3 to 2 per cent, being greatest in an unlagged cylinder.

Ans. 6—The oil engine, the increase being 400 per cent

Ans. 7—The two halves of the bearing must be tightly fastened to the rod. Fine threads are used on the bolt for the reason that for a given force exerted on the wrench for a given distance, the pressure between the bearing parts will be the greater with the finer thread. If the force pressing the parts together be called N and the force at the wrench end F, the length of the wrench R and the lead of the screw—that is, the reciprocal of the number of threads per inch—be called P, then

$$\frac{N}{F} = \frac{2\pi R}{P},$$

or the greater the number of threads the greater is N.

Ans. 8—If the water was at 60 deg. F., the pressures in the two boilers would be the same, but as the water is 180 deg. F. the weight of water per foot of head is less; the steam boiler would be under the greater pressure.

Ans. 9—Most belt men have the lap made so that the thin edge next to the pulley points away from the direction of belt travel, but the largest user of belts in this country reverses this practice. The argument is that if the outside lap is toward the direction of travel, the air friction will cause the top to curl and so loosen the lap.

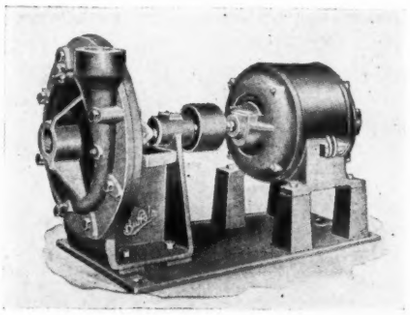
Ans. 10—This gas is obtained from natural gas coming from the northwest Texas fields. The natural gas, which is piped to Fort Worth and Dallas for heating purposes, is put through a compression plant, where, by compression and cooling, the helium content is recovered. It is both light and inert.

PLANT EQUIPMENT NEWS

New and improved equipment in power and industrial plant fields, and new applications of existing equipment

Buffalo Class "CH" Pump

THE Buffalo Steam Pump Company, Buffalo, N. Y., has recently added to its line of centrifugal pumps the class "CH" pump illustrated. According to the manufacturer the pump has been brought out to meet



Direct-connected class "CH" Pump

the demand for a moderately priced high-efficiency unit.

The pump is of the single-stage, single-suction type and is made in a number of sizes with capacities from 10 to 225 gal. a minute with a total head of 100 feet.

The pump casing is of cast iron and is so bolted to the bearing stand that the discharge may be taken off at any of eight different positions. The suction and discharge openings are taped on the No. 2½, and smaller pumps and flanged on the No. 3 pumps and larger sizes. The impeller is of cast iron and of the open type. The shaft is of high-carbon steel and is carried in two bearings, the one next to the coupling being a ring-oiled one-piece bronze bearing and the one next to the pump casing a long bronze sleeve pressed into the bearing stand and grease lubricated. To take care of end thrust, a set collar is located inside the ring-oiled bearing housing.

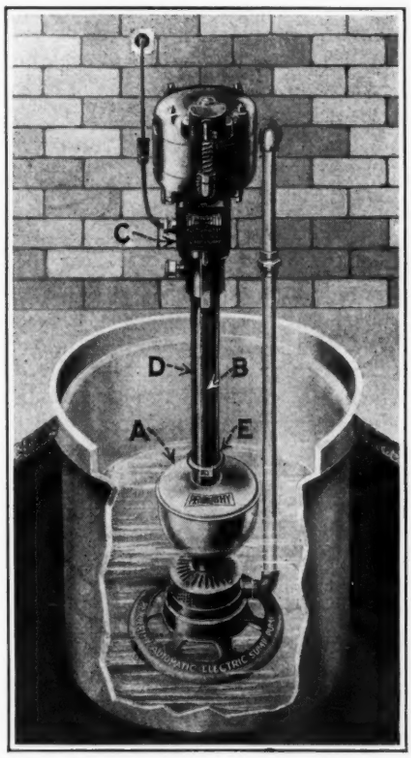
In the direct-connected units the pump is connected to the motor by means of a specially designed combined pulley, pin and rubber bushing type coupling. The pulley is of the standard cast-iron crown-faced type, and for belt driven pumps the pulley half only of the coupling is furnished.

Pumps with bronze or inclosed-type impeller and monel-metal shaft can be furnished on special order.

Penberthy Electric Sump Pump

THE Penberthy Injector Company, Detroit, Mich., has recently added to its line of products the automatic electric sump pump shown in the illustration.

As will be apparent from the illustration, the pump is of the self-contained, self-supporting type, designed for placing directly on the



Typical installation of pump

bottom of a sump or well without the use of a supporting cover to fit the various sizes of sump casings or well forms.

The motor is fitted with ball bearings and is coupled to the impeller shaft by a flexible coupling, the shaft itself being supported at the top by a ball bearing.

The control for the pump consists of a float *A*, switch control arm *B* and a simple mercury type switch *C*. The float is made to slide freely on the supporting column *D*, which carries the pump bearings and incloses the impeller shaft. The adjustable bronze ring *E* governs the water head at which the pump starts.

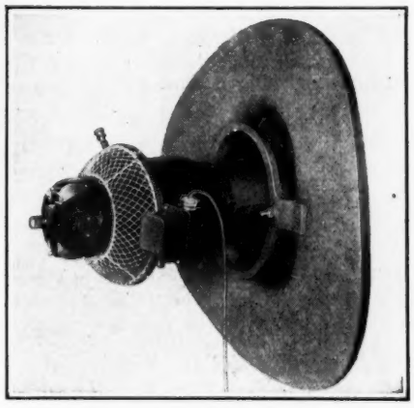
The pump is of the balanced, open-impeller type and is provided with a large-area strainer directly above it. With the strainer in this position the inlet to the pump is well above the possible sediment deposit at the bottom, and as the lower position of the float is definitely fixed above the strainer, the pump is always primed.

The pumps are made in ¾- and 1-in. discharge pipe sizes and for discharge heads up to 20 feet.

Coppus Manhole Blower

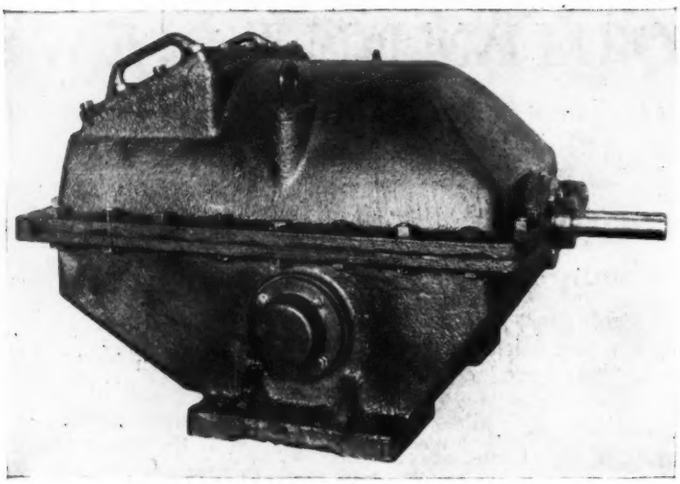
IN THE Feb. 28 issue brief mention was made of the manhole blower brought out by the Coppus Engineering Corporation, Worcester, Mass. This blower is an adaptation of the "Coppus Heat Killer," which was announced by this company about a year ago and which is designed for protecting workers in power plants, steel mills, foundries and other plants where excessive heat is encountered.

The illustration shows the "Heat Killer" converted to a manhole



Blower mounted in boiler manhole

blower. The unit is fitted with a special manhead and yoke by which it is readily attached to the boiler manhole. The universal motor used to drive the blower can be used with direct or alternating current of any frequency, and 110 or 220 volts. The total weight of the unit manhead and yoke included, is 65 pounds.



Exterior of explosion-proof motor

Motors for Use in Explosive Atmospheres

A LINE of both alternating- and direct-current motors, built for application where explosive gases, fumes or dust are present, is announced by the General Electric Company. These motors have been approved, as a result of tests, by the Underwriters' Laboratories for operation under such conditions. The announcement of the complete line marks the culmination of several years of successful application in individual sizes and rating.

The object of the special construction is to reduce the danger that heat, generated inside the apparatus from any cause whatever, will be transmitted to the outside in such intensity as to ignite gases surrounding the equipment. As shown in the figure, a two-piece cast-iron exterior is provided, heavy enough to withstand the pressures of an internal explosion and with flanged joints sufficiently wide to cool the flame of any such explosion. No gaskets are used, as it is not intended that the motors should be gas-tight.

The internal mechanical and electrical features follow the design of standard General Electric alternating-current and direct-current motors. The electrical characteristics are primarily the same as those of standard totally inclosed motors. The alternating-current motors are available in single-phase ratings up to three horsepower and in polyphase ratings up to fifteen horsepower, at standard voltages and the more popular speeds. The direct-current motors may be either shunt- or compound-wound types with the horsepower ratings from three-eighths to five at the standard speeds and voltages.

All these motors, either alternating- or direct-current types, are designed to operate within a temperature rise of 55 deg. C., the standard for inclosed motors.

Milburn Type T-1 Torch with Adjustable Tip

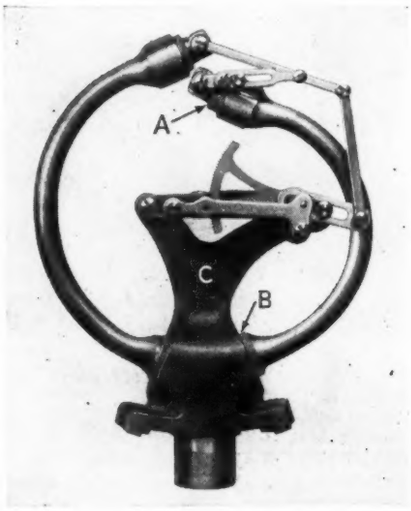
A COMBINED cutting and welding torch known as type T-1, in which the change from one to the other is readily made by merely turning the tip, has been introduced by the Alexander Milburn Company, 1416-1428 West Baltimore Street, Baltimore, Md.

With the tip in one position the gases are passed through the preheating gas passages, while the high-pressure oxygen is carried through the center hole for cutting. In the next position, made by a quarter-turn of the tip, the cutting oxygen is cut off and the welding gases are conveyed through the central passage of the cutting tip, giving a welding flame.

In the new torch the principle of supermixing used on other torches made by this company has been retained. The torch head, valves, base and other parts are of bronze forgings, and the seamless high-pressure tube is specially drawn with triple-thick walls and is of nickeled silver. It is pointed out by the manufacturers that the type of tip used, is serviceable as a welding tip even after it has outlived its usefulness as a cutting tip.

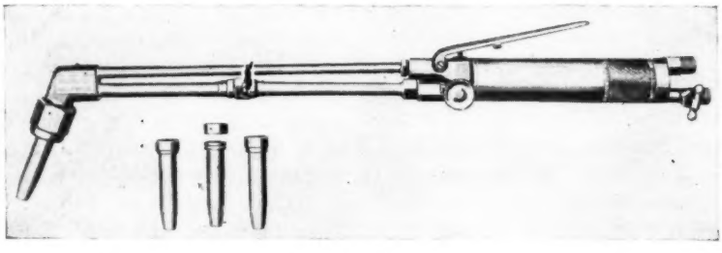
Crosby Screwed-End-Tube Pressure Gage

IN THE double-tube pressure gage for high pressures and temperatures brought out by the Crosby Steam Gage & Valve Company, Boston, Mass., screwed connections are used at the tube ends, as at *A* and *B* in the illustration, instead of being soldered or brazed, as is the usual practice.



Steam gage with screwed-end tube connections

The tubes are made of a special bronze and are machine turned, not drawn, then formed to the required shape. The complete moving mechanism is independent of the case, it being supported from the connection casting *C* which is fastened to the case only at the bottom. The gages are being made in sizes from 6- to 16-in. and for pressures from 100 to 1,000 pounds.



Combined cutting and welding torch with nozzles

A.C.C.O. Electric Elevator Door Operator

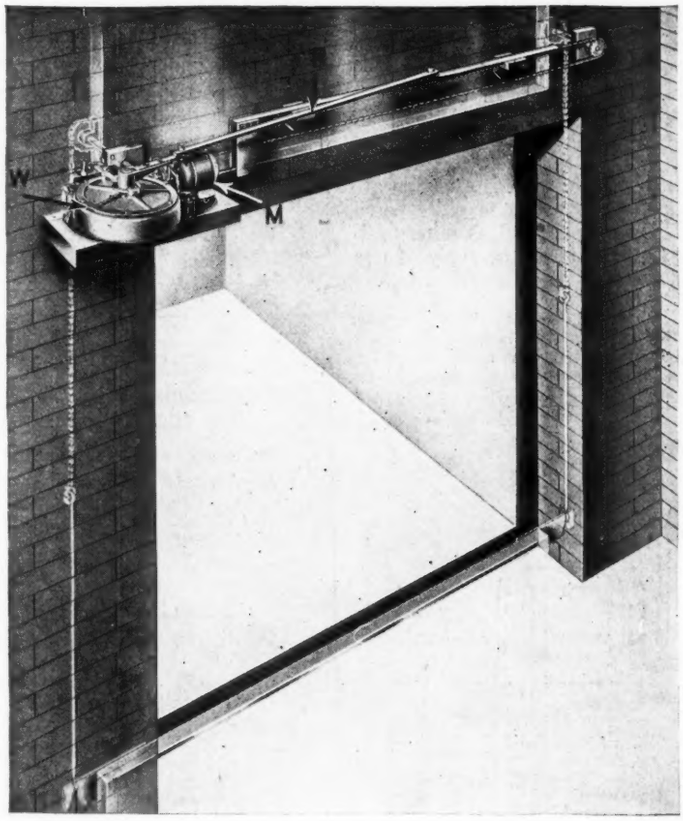
AN ELECTRIC operator for elevator doors has been placed on the market by the Automatic Control Corporation, Detroit, Mich., a subsidiary of the Riley Stoker Corporation, Worcester, Mass. In the figure this equipment is shown installed for operating vertical sliding doors. One operator is placed on each set of landing doors. To work the car gate an operator can be mounted on the car crosshead.

The device consists of a totally inclosed worm gear *W* directly connected to a motor *M*. On the worm gear shaft is an arm that connects to the door-operating mechanism by rod *R*, the doors being connected to the operator by sprockets and chains. Limit switches are provided to stop the motor at the open and closed positions of the doors. A brake prevents overtravel of the motor. A push-button switch, in the car or on the hoistway wall, starts the motor, which, through the worm gear, rod and chain connections, moves the doors to the open or the closed position. The doors are under the control of the operator at all times. If the doors are partly closed and the operator wishes to open them again, pressing the open button will reverse their motion.

The operation can be made automatic, so that when the car comes within ten inches of the floor and the car switch is centered, the doors will open. Through a master interlock the car can be moved within this ten-inch zone. On micro-leveling elevators the electric operator automatically opens the doors when the elevator is in the micro zone.

On some installations where there are both front and rear landing doors on the hoistway, selective operation can be obtained for either the front or the rear door or both at the same time.

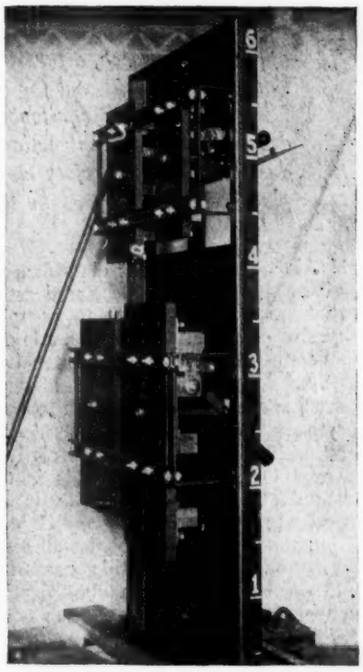
The electric operator is so designed that it imparts harmonic motion to the doors. This means that the doors have a slow motion near the open and closed positions. The full speed of the opening and the closing operations occur at the one-half open or one-half closed position. This allows operating the doors at high speed without slamming. Only 3½ sec. are required to complete the opening or the closing operation of a ten-foot door.



Operator installed on vertical moving elevator doors

New Type Back-of-Board Switches

THE demand for safety in switching operations of the low-voltage class is met by the Westinghouse Electric & Manufacturing Company in its announcement of a new line of back-of-board knife switches. They are mounted on steel panels of the dead-front type and are particularly adapted for industrial control and central-station auxiliary equipment applications.



Back-of-board knife switches mounted on steel panel

Each switch and its operating mechanism is mounted on a slate base behind the steel panel, with only the operating handle passing through the panel, as in the figure. Complete accessibility of the switch and fuses from the front of the switchboard is provided by means of a fuse door. This is interlocked with the switch handle so that the switch must be in the full open position before the fuse door can be opened and the switch cannot be closed while the door is open.

These switches are available in a large number of combinations. They are made for 250 volts direct current and 500 volts alternating current and for capacities ranging from 30 to 800 amperes. They can be obtained in one,- two.- three,- or four-pole units, fused or unfused, and with or without attachments for quickly opening the circuit.

Pulverized Coal in
Stationary Railway Power Plants—II

The first part of this report of the Subcommittee on "Coal Fired Plants" of the International Railway Fuel Association, which appeared last week, discussed broadly the advantages and limitations of pulverized coal for plants of 100 to 600 hp. This installment discusses the equipment itself, such as unit mills, furnace design and wall construction. Burners, flame lengths, slagging, dust precipitation, safety measures and the economics of existing plants will be covered in the remaining sections of the report.

IN ALL the equipment classifications given below, it should be understood that no claim is made to complete comprehensiveness. Effort is made only to cover the equipment more extensively employed in America. It would be almost a hopeless task to attempt to cover everything that had been patented or even that had been used commercially on one or two installations. This is true with pulverizers and water walls and particularly true with air-cooled walls and burners. The air-cooled wall situation is so complicated this committee would not even attempt a classification. Inventing burners seems a vice to which every young powdered-coal engineer is prone to become addicted. Experienced equipment manufacturers number among their possessions literally dozens of such untested or half-tested patents. In burner design particularly, it is safest to demand a wealth of past experience on the part of the manufacturer. At least two or three successful installations with comparable coal and operating conditions should be the minimum requirement specified by the conservative purchaser.

Power Consumption and Fineness

One of the general questions asked all the builders was: "State the kilowatt-hours per ton, fineness and moisture content with the following coals, (a) Pocahontas, New River or equal. (b) Pittsburgh or equal. (c) Illinois or equal. (d) Sub-bituminous. (e) Lignite."

Before the replies to this question are given, an explanatory note quite pertinent to this reply as well as others following, is quoted from the reply of one manufacturer:

Several of the questions asked involve the fineness and in line with the customary practice this has been given in terms of a 200-mesh Tyler standard screen. We contend that pulverization should not be measured in terms of 200-mesh material. Experience shows that the percentage remaining on the coarser mesh screens such as 48-50 or 65-mesh, bears a much more important relation to good combustion. Two different coals may show a fairly definite similarity in the percentage through 200-mesh, yet that remaining on the coarser screens may vary 100 per cent or more. The 100, 150, 200 and finer mesh fuel can be considered as material that will certainly be consumed thoroughly in the furnace. There is a doubt as to the possibility of thoroughly consuming the coarser particles before they deposit in the furnace or are carried into the boiler tubes. With a definite limit placed upon the percentage of this coarser fuel, it is believed that much better combustion will result than where the pulverization is measured only in terms of finer sizes.

The Committee endorses this suggestion. Note should also be taken of the fact that to date, it has not been possible to agree upon any generally accepted standard method of taking samples of coal from a unit mill. In making comparisons, therefore, of the efficiency of pulverization of different mills in kilowatt-hours per ton, care should be taken that all samples are procured by the same method. Although the American Society for Testing Materials to date

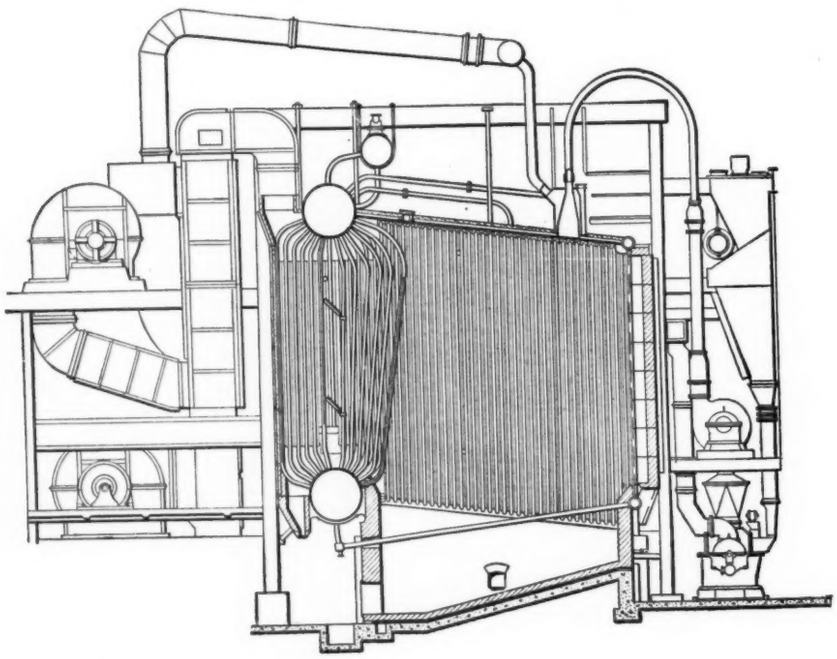


Fig. 7—Showing design of furnace as employed at Atlas Portland Cement Company, Northampton, Pa.

Classification of American Commercial Unit Pulverizers

Impact and Attrition Mills

High Speed (900-1800 *r.p.m.*).

Paddle Type

Aero.
Erie City.
Simplex.
Warrior.

Swing Hammer Type

Imp
(horizontal shaft).
Grindle
(vertical shaft).

Intermediate-speed (500-700 *r.p.m.*) *Elutriators.*

Strong-Scott.
K-B (Illinois)

Low-speed (20-35 *r.p.m.*) *Air-swept tube mills.*

Single Flow.

Kennedy Van Saun.

Recirculating

Bonnot.
Hardinge.

Attrition on Buhr Mills

High Speed (1,200-1800 *r.p.m.*).

Attrita.

Roller Type, Vertical Mills

Moderate speed (100-300 *r.p.m.*).

Raymond.
Fuller or Lehigh.
Bethlehem.

only offer a "Tentative" method of sampling (A.S.T.M. Serial Designation D-197-26-T) this Committee recommends that bidders be asked to state their figures from samples taken by this method until A.S.T.M. or others agree upon a better one.

Based on 2,000 to 4,000 lb. capacity machines at or near their rated capacity, representative average conservative replies to the foregoing questions were:

Coal	Kw.-Hr. per Ton Total for Mills and Fan	Fineness Through 200-Mesh Per Cent	Moisture Content Per Cent
Pocahontas, New River or equal	17-18	70-75	10-12
Pittsburgh or equal	18-22	68-72	10-12
Illinois or equal	20-25	65-70	12-15
Sub-bituminous	18-22	70-75	12-18
Lignite	16-20	70-75	26-40

Only one contributor offers figures on the grinding of anthracite in unit mills, giving a figure for an air-swept mill of the ball type of 20 kw.-hr. per ton for the mill only. He does not give fan figures, which would probably bring this up to a total of around 30 kw.-hr. per ton. It is necessary to grind anthracite to 85 per cent through 200-mesh, otherwise it is difficult to light off, to sustain flame propagation or to keep down loss of unburned combustible. Other contributors do not recommend the pulverizing of anthracite in unit mills on account of the high mill maintenance cost and excessive power consumption to obtain the desired fineness.

Figures of power consumption lower than the foregoing are given by a number of manufacturers, while some are slightly higher.

Ratings of Smallest Pulverizers Built

One developed boiler horsepower-hour will require from a little over three to a little less than five pounds of coal, depending on the B.t.u. content of the coal and the efficiency with which it is burned. Taking a rough average as 3.5 lb. per hp.-hr. then a 250-lb. mill would develop 70 hp. total, a 400-lb. mill 114 hp. (a 66 in.x16 ft. boiler at 114 per cent of rating), a 2,000-lb. mill, 571 hp. (a 350-hp. boiler at 154 per cent of rating), etc. Present-day coal pulverizers operate by far the best at or near full load. Many require a large percentage of their full load power even at very light loads. As a result, power consumption per ton on a pulverizer designed for a heavy load may be prohibitive on light loads even though the job of grinding done is quite satisfactory. Thus the cost of auxiliary power required on a small installation improperly applied may more than eat up the expected savings. Other things being equal, the object is to choose that size machine whose maximum capacity is nearest to anticipated requirements.

The following question was asked all the builders: "What is the maximum rated capacity of the smallest unit pulverizer you manufacture and on what coal fineness and dryness is this capacity based?" The replies follow in order of size:

Pounds Coal per Hour	Moisture Content of Coal	Per Cent Fineness Through 200-Mesh
200	7 per cent	85
250	10-12 per cent	75-80
400	up to 15 per cent	80-85
500	up to 12 per cent	not stated
1000	regardless moisture	98 per cent through 50 mesh
1250	various moistures	60-80
1800	5 per cent	65
2000	various moistures	70-80
3000		

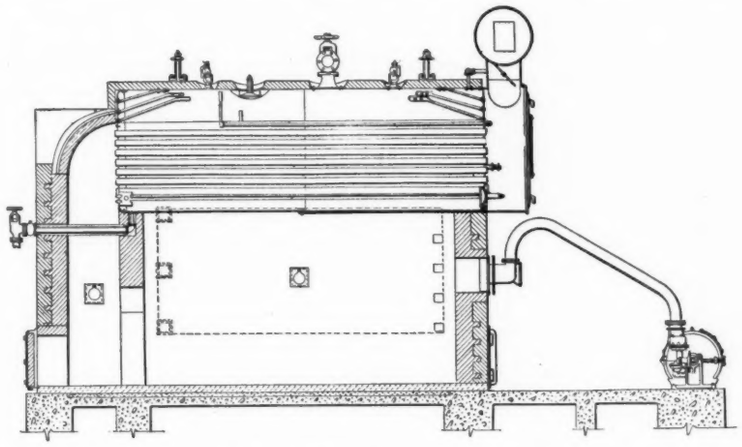


Fig. 8—Typical layout for horizontal return-tubular boiler

Furnace Design

Fig. 7 shows a typical vertical, water-tube boiler furnace installation at the plant of the Atlas Portland Cement Company, Northampton, Pa. Combustion Engineering Corporation Mills serve vertically fired water-cooled furnaces having a slag screen at the bottom, and burning Eastern bituminous coal. Plate-type air heaters recover the heat from the exhaust gas, which is returned to the furnace as preheated secondary air at the burners.

Fig. 8 shows a typical horizontal return-tubular boiler installation. This represents a standard setting for an 84 in.x20 ft. h.r.t. boiler as offered by the Fuel Efficiency Engineering Corporation (Warrior). Several contributors report these small installations on as low as 66 in.x16 ft. boilers, showing remarkably high efficiencies (75 to 78 per cent) and maximum ratings of 150 and 200 per cent. Care must be taken in these small installations that small and inexpensive pulverizers be specified, otherwise high auxiliary power costs and fixed charges may more than eat up the savings calculated.

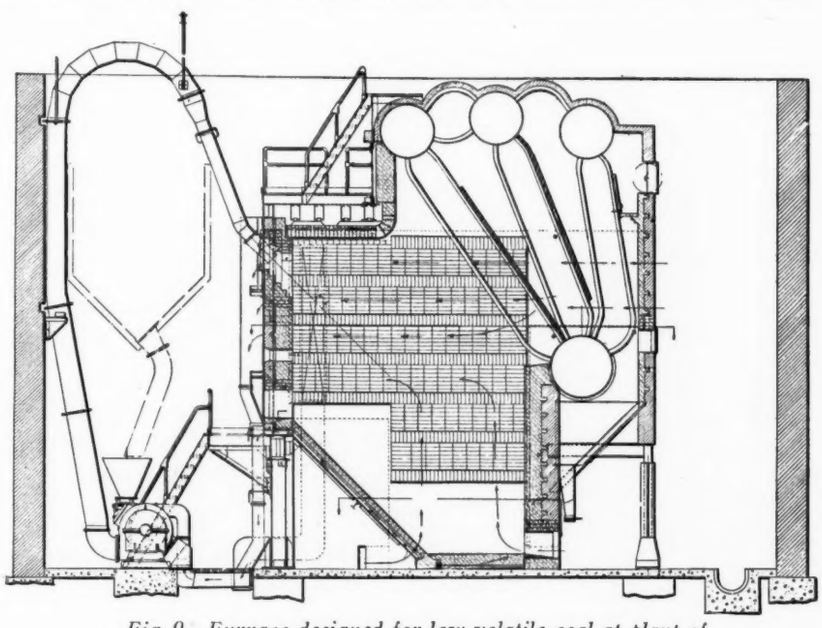


Fig. 9—Furnace designed for low-volatile coal at plant of Berwind White Mining Company

Fig. 9 shows a typical installation of a furnace fired with low-volatile Eastern bituminous coal of medium high-fusion ash. These are 5,000-sq.ft. Stirling boilers equipped with Aero pulverizers and air-cooled walls at the Berwind White Mining Company, Berwind, W. Va. The boilers are operating at 200 per cent of rating with an average efficiency of 77 per cent and coal having an ash fusion of 2,400 deg. F. The heat release is 18,000 to 20,000 B.t.u. per cubic foot of furnace. Note the inclined firing floor and rear-end ash removal.

Fig. 10 shows typical installation of furnace fired with Illinois coal. It consists of eight B. & W. boilers of 2,500 sq.ft. each, fired by Aero pulverizers at the Standard Steel Car Company, Hammond, Ind. The average operating efficiency is 76 per cent, and a test efficiency 79.2 per cent has been developed. Maintenance with Illinois coal approximates 3 cents per ton.

A typical solid wall construction is shown in Fig. 11, consisting of a 4,500-lb. Riley "Attrita" mill applied to a 3,860-sq.ft. horizontal longitudinal drum boiler at the plant of the Larkin Company, Buffalo, N. Y. The furnace is operated up to 220 per cent of rating using low volatile "Murray Hill" coal. An efficiency of 77.4 per cent at 164 per cent of rating has been shown on test. Usually, solid wall construction is confined to service requiring maximum ratings of 200 per cent and less in rather liberally designed furnaces burning coal having ash fusions over 2,400 deg. F.

Air-cooled wall construction makes possible somewhat higher ratings in the same furnace than solid wall construction and permits the use of somewhat lower fusion ash coals with reasonable excess air and maintenance. Perhaps their principal advantage is that they furnish a source of hot air to the mill.

Water, ash or slag screens and water-cooled furnace bottoms, particularly when combined with air-cooled vertical walls and vertical firing, make possible still higher ratings and heat releases per cubic foot of furnace volume. They also permit the use of still lower ash fusion coals with reasonable excess air and maintenance. They still make possible the hot primary air for drying from the hollow walls. Owing largely to the patent situation, these screens or furnace bottoms run rather high in price, ranging from $22 per square foot installed upward, depending on tube spacing and design. Fig. 12 shows a successful installation of a slag screen furnished by the Combustion Engineering Corp. for 5,000-sq.ft. Heine boilers. Illinois low-fusion ash coal is burned.

Fig. 13 represents a section of a typical water-cooled furnace wall construction on a 5,110-sq.ft. Erie City three-drum boiler with an integral economizer.

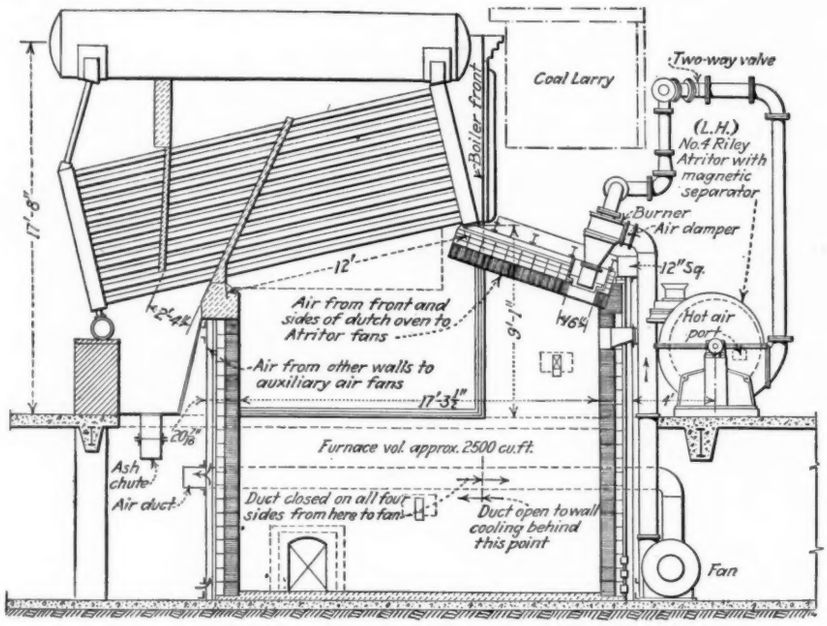


Fig. 11—Solid wall construction at Larkin Company, Buffalo

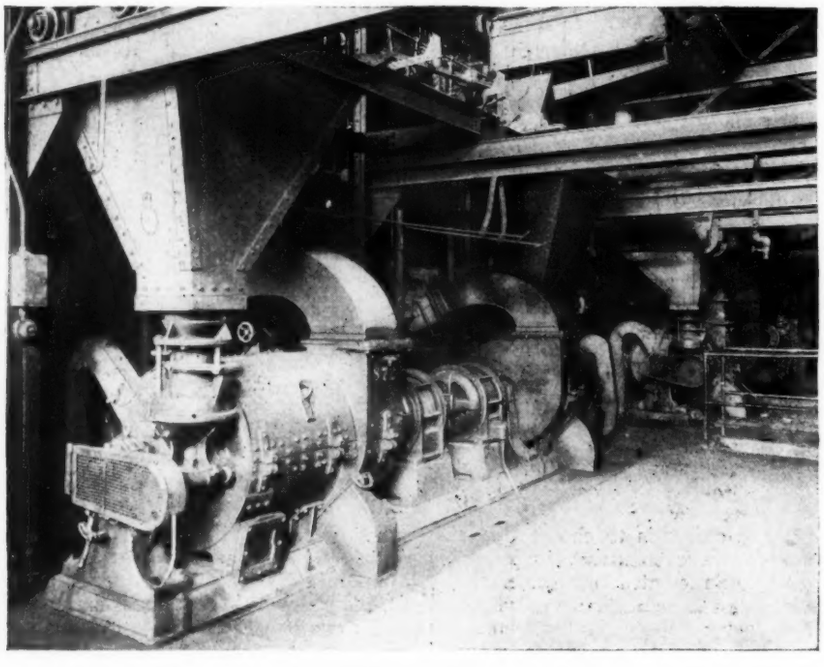


Fig. 10—Installation at Standard Steel Car Company, using Illinois coal

Water walls offered commercially on the American market may be divided into two classes: (1) The metal-faced, exposing either the surface of the cooling tube or an expanded metal surface attached thereto direct to the heat of the furnace; and (2) the refractory-faced, which interpose refractory tile as a screen against the more intense radiant heat of the flame. A classification of the better known water walls follows:

Refractory-Faced
- Metal block cast around refractory facing and clamped to tube (Bailey).
- Refractory tile laid against tube (Seymour).
- Carborundum tile laid against tube (Cannon).
- Carborundum block clamped to tube (Bernitz).

Metal Faced
- Fully exposed tube in front of solid wall (patents expired).
- Tube exposed but partly embedded in refractory (patents expired).
- Fin Wall—extended surface (Murray).
- Metal Block clamped to tube (Bailey).
- Metal Block cast to tube (Drake or Coutant).
- Metal Block sweated or welded to tube (Foster-Wheeler).
- Exposed closely spaced bifurcated tube—(The Superheater Co.).
- Exposed closely spaced tubes with hand holes eccentrically placed in header to permit close spacing—(Walsh & Weidner).

Advantages claimed for all water cooled furnace wall construction are:

1. Higher rates of heat liberation are possible.

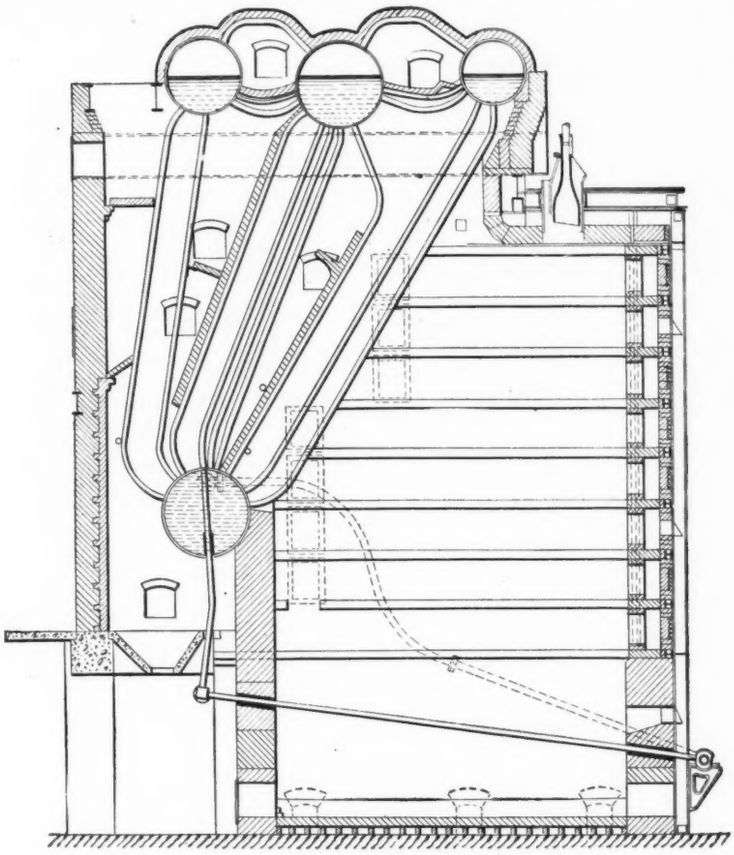


Fig. 12—Slag screen for use with low-fusion coal at Western Shade Cloth Company

2. Operation with lower excess air is permissible.
3. Water walls reduce smoke, unburned gas and carbon loss.
4. There is a minimum of air leakage and infiltration into the furnace.
5. A wider selection of coals of varying quality is possible.
6. Greater steaming capacity of the boiler unit is obtained due to the heat absorbed in the furnace walls.
7. Wall erosion or clinker formation is prevented.
8. Greater furnace heat liberation capacity permits reduced building size.
9. Furnace and wall maintenance is reduced.
10. Boiler outage is reduced.

Additional advantages claimed for refractory faced construction are that they:

1. Provide for protection against spots of localized heat and blistering of tubes.
2. Make possible a variation in detail design and selection of refractories, allowing the building of walls especially adapted to the specific fuel and operating conditions.
3. Permit a wider range of operation. No danger of fire going out or operating with smoke at low ratings.
4. Prevent loss of unburned combustible and smoke formation from pulverized fuel travelling in the cold zone immediately adjacent to and in front of the metal-faced walls.
5. Permit a hotter, hence a more efficient furnace.
6. Permit milder and more uniform heat absorption and steam generation in the cooling tubes so that the mixture therein contains a higher percentage of water and a lower percentage of steam, thus again minimizing the possibility of tube blistering.

The trend of five to ten years ago in powdered-coal firing was generally toward vertical or inclined stream-flow firing. The last few years have seen a rather marked trend toward horizontal turbulent-burner firing for most applications. For the 1,000- to 6,000-sq.ft. boilers, with which this report is principally concerned, the consensus of opinion seems unanimously in favor of horizontal or slightly inclined firing with

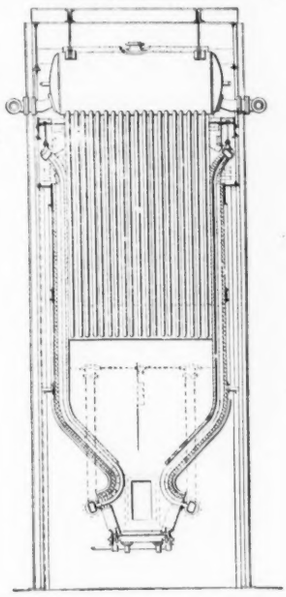


Fig. 13—Typical Erie City water-cooled furnace construction

turbulent burners wherever possible; vertical firing being employed only where furnace dimensions make horizontal or inclined firing impossible.

Fig. 14 shows a typical installation of horizontal firing with turbulent burner as installed at the Chase Metal Works, Waterbury, Conn., by the Furnace Engineering Company ("Simplex").

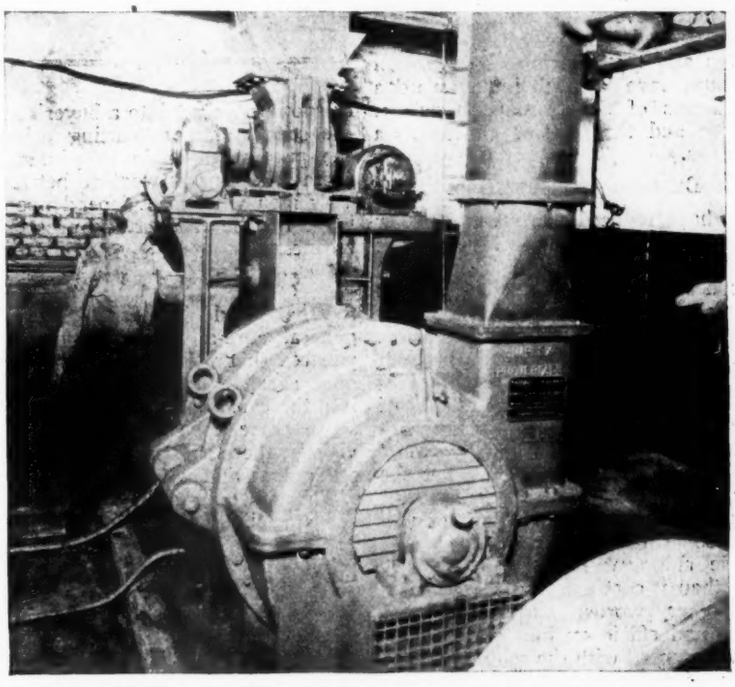


Fig. 14—Horizontally fired boiler with turbulent type of burner at Chase Metal Works, Waterbury, Conn.

The Trouble with This Business of Buying

The Basic Causes of Price Cutting—Where the Seller and the Buyer Are Responsible—Three Things to Do About It and Two Recommendations for a Course of Action

By Earl Whitehorne

Assistant Vice-President, McGraw-Hill Publishing Company, Inc.

EXECUTIVES of American industry realize today that they have made a serious mistake through the last quarter century. They have allowed themselves to become so absorbed in the problems, the achievements and the fascinations of production that they have neglected distribution. Our methods of distributing our goods have grown by main strength and awkwardness.

Neglect of Purchasing

This tremendous increase in production has brought with it an intense pressure on sales. The growing output of the factory has been driving the salesman to desperate ingenuity. And American industry has also become so engrossed in selling that it has neglected the efficiencies of purchasing. The world has honored and courted the salesman, while the purchasing agent has gone his way unseen and unsung. And yet for every sale there must be a purchase, and the practices and the policies and the principles of the man who buys have as much influence upon the success of the transaction as the methods and the motives of the man who sells.

By Guess and By God

We have reduced our manufacturing to a science. We think in terms of B.t.u.'s per pound of coal. We invest thousands of dollars in machines that will make possible the continuous saving of a fraction of a cent. We select and organize our labor and support each operator with four and a half horsepower. We govern the very motion of a man's hand. Yet we do our purchasing too often "by guess and by God," we sell at whatever price will get the order, and we deliver the goods by an overgrown mechanism of distribution so cumbersome that it often costs more to get the shipment into the customer's hands than it cost to manufacture.

In other words, while we pour science and efficiency into our production, we proceed with the selling and the buying of these commodities that we have so zealously and skillfully produced, by a system so hit-or-miss that as soon as we get into a buyer's market, the sellers start to cutting prices and the purchasers begin to profiteer and there is a general warfare between the very men who must depend upon each other for the conduct and prosperity of business.

The prevalence of price cutting, the unprecedented demand for special equipment and the cost of servicing such equipment are matters that are today worrying many manufacturers of power equipment. Power *has devoted considerable space to the subject both editorially and in special articles, one of which was by Mr. Whitehorne in the March 20 issue on "Practices in Price Cutting."*

The Seller's Weakness

What should be done? There is no general cure-all for price cutting—no panacea that will save the world. The only sensible approach is to examine into the causes and see if any common-sense corrections can be found. Obviously, there are two causes—what the seller does and what the buyer does.

The seller in a buyer's market becomes afflicted with over-production. This brings on an acute attack of volume-itis and pressure is put upon his salesmen to get orders. At the buyer's doorstep his salesmen meet other salesmen who are suffering from the same anxiety. Some of them are armed with the weapon of cut price. To get orders, to get volume for the factory, they have been told to sacrifice the profit. They do. And when one does, many do. And this induces a kind of hysteria, a state of mind that is just a form of fear. It is price cowardice. It is a kind of mob psychology that will sweep right through the salesmen of any branch of any industry.

There is only one thing that cures this kind of demoralization. If the salesman's boss possesses the intestinal fortitude to control him and to lead him out of his fear, it can be stopped. Otherwise it runs its course till it ceases from exhaustion.

Price Courage

It is a simple thing—price courage. When a manufacturing company enters the market with a line, its officials set a schedule of prices based on their costs, which in turn are regulated by competitive conditions. If the president of that company will permit his sales manager to come in and talk him into permitting a price cut to get some big order and the salesmen find it out, then the salesmen will everlastingly be importuning the sales manager to let them cut to meet another bidder on this job and that. But when the sales manager knows that the president has price courage, that gives him the guts to stand up against the salesman. And when this salesman knows that the sales manager also has price courage, he will battle with the buyer and refuse to telephone the office and ask a better price.

To put it flatly, the salesman who believes in his boss carries price courage wherever he calls. Price cutting is not the salesman's fault. It is the fault of the executive who cannot face the fact that the only relief in a market demoralized by over-production and price cutting is reduced production.

The Buyer's Weakness

In the beginning the boss did the buying in odd times. Then he detailed a young man to help him. As buying has grown in volume, purchasing agents have become more important, until today in many progressive corporations the buying is done by a vice-president with an able staff, and he is a big man with a broad knowledge of markets and

men. But in too many cases the purchasing agent still lacks the responsibility and authority he needs to make his job measure up to his titular function. Too often he is just expected to buy what he is told and his performance is measured by his ability to save on price.

Four Factors of Value

As one large buyer stated, There are four factors in every purchase that should be given consideration in the order named:

1. Suitability to the need.
2. Quality of the article.
3. Responsibility of the vender.
4. Price.

Price is only one of the elements that must be weighed in establishing a value, and it should not be considered until the other three factors have been established as satisfactory.

If the purchasing agent is to contribute his share toward overcoming this practice of price cutting that industry is suffering from, he must face these facts, and, facing them, he will bring new dignity to his profession and new opportunity to himself.

We have too little accurate knowledge of what it costs to buy—too little recognition of the relative importance of value as compared with the mere price factor, too little measuring of price against the other factors.

What to Do

There are four things to be done:

One. If the purchaser would demand firm bids, general price cutting would soon cease. For a firm bid is like a signed order. It's the word of the house.

Two. While this practice of firm bids is crystallizing into a custom, whenever bidders are called back by a purchasing agent and asked for a better price, let the bidder demand that the other bids be shown to him, so that he will know that he is not being lied to and that his price is indeed high for equal value.

Third. And while the trickery of baiting bidders still continues in the world of business, let bidders hold post-mortem comparisons of bids, by submitting their bids on closed business to their trade associations for comparison and report.

Four. And let the buyer frankly and publicly proclaim that he will thereafter shun the man who cuts his price, because the first price is supposed to represent the honest value of the goods, and the man who cuts stands self-convicted either of trickery or weakness.

Price cutting is just an economic disease. It can be cured. It can be cured by public opinion within industry. And immediate relief can be sought only through the building of public opinion among buyers and sellers. But the only way there is to develop public opinion is by discussion that corrects loose thinking and makes clear the moral and economic principles which all men desire to follow once they are generally understood.

This calls for leadership. This leadership can best come from two sources—the industrial associations and the industrial press.

Nine Thousand Attend N.E.L.A. Convention in Atlantic City

Exhibition Large and Well Attended—Three Million Dollars To Be Spent for Ten-Year Program of Engineering Research

MORE than nine thousand delegates and registered guests attended the fifty-first annual convention and exhibition of the National Electric Light Association, held at Young's Million Dollar Pier, Atlantic City, June 4-8.

While the major part of the meeting program was devoted to such matters as accounting, distribution and public relations, there were a number of sessions and papers of interest to those whose main concern is the economical and reliable generation of power.

The exhibits held in connection with the convention occupied all available space on the huge pier and overflowed into other buildings. A substantial portion of the exhibition was devoted to equipment for the generation of power and its industrial utilization.

Through the co-operative efforts of the electrical industry three million dollars will be spent for research during the next ten years, according to an announcement made at the meeting. For each year a sum of $300,000 has been made available in conformity with this program. This announcement marked the acceptance of recommendations made by A. D. Bailey, superintendent of generating stations for the Commonwealth Edison Company, Chicago.

A. D. Bailey Urges Research

Mr. Bailey, speaking at the Engineering Section meeting on June 5, outlined the present status of research in the electrical industry and related fields.

"The industries whose research expenditures were the largest five years ago," said Mr. Bailey, "are those which have scored the greatest relative advance since then. So rapid has been the extension of research work that whereas in 1921 only 578 companies were known to maintain research departments or laboratories, more than one thousand concerns have organized research divisions in operation at the present time. It is estimated that we as a nation spend two hundred million dollars annually on industrial research.

"However, the amount that is spent on engineering research is relatively small and when we finally get down to that part in which the electric light and power industry is interested financially or otherwise, we find it ridiculously small compared to the magnitude of the business. Despite the importance of engineering work, engineering and industrial research has the least endowed support of any field. Yet the electrical industry alone did a gross business of one and three-quarters billion dollars last year."

Mr. Bailey outlined and praised the research projects being carried out under the auspices of the parent engineering societies, but pointed out that the support for such research comes mainly from the outside—from the interested companies and industries. The technical societies, he said, have very limited funds for carrying on this work.

In contrast to the research expenditures of the engineering societies, Mr. Bailey cited the American Railway Association, with an organized research program calling for the expenditure of two million dollars yearly, with a quarter million for air-brake equipment alone. "Here is an industry," he said, "that has centralized its research work so that it will be co-ordinated and the money will be spent to best advantage without duplication of effort."

"It is recommended," Mr. Bailey concluded, "that a research committee be set up in the Engineering National Section. Such a committee would do a great deal toward clarifying and simplifying this whole situation. It should be authorized to carry on specific research projects. It would pass upon projects brought to it, distribute the work among different universities, laboratories and other agencies and would enter into co-operative agreements with other interested industries."

At the same engineering session W. E. Mitchell, vice-president, Georgia Power Company, made a strong appeal to engineers as a class, and particularly the utility engineers, to broaden their vision and get more business into their thinking. "Engineers," said Mr. Mitchell, "must learn to consider the broader problems of production, finance and organization. Why is it that lawyers and salesmen have so frequently taken precedence over engineers in advancement to positions of executive responsibility? Is it that the engineer has failed to get a real money sense with all his spending? The wise engineer will not forget that the utilities are largely dependent on the investment banker.

Engineers Should Seek Responsibility

"I say to you engineers, broaden your field, lift up your heads and eat up all the responsibility you can get. The engineer had better study men if he wants to see his projects go beyond the desk stage. There are plenty of good desk engineers, but the ability to apply knowledge and lead men is still at a premium.

"In proposing to spend money," Mr. Mitchell concluded, "put yourself in the boss's place. Answer that perpetual why. Make your pet run the gauntlet of all the questions that might be asked. The engineer must lose his reluctance to accept suggestions from the outside. He must learn to stand on his feet and present his ideas so that others will understand and accept them. He

must learn to forget his pet hobbies and take a broader view."

At the same session E. C. Stone, of the Duquesne Light Company, Pittsburgh, Chairman of the Engineering National Section, outlined the activities of the Section and its future plans. "Economy data covering one year's operation of ten representative plants for pressures from 310 to 1,200 lb.," said Mr. Stone, "show lower heat consumption for the higher-pressure stations, but there is a greater tendency on high pressure to scale formation and more attention must be given to feedwater treatment. The increased use of evaporators with and without chemical treatment is reported. Air pre-heaters for temperatures varying from 400 to 500 deg. F. have been installed with good results.

"The use of pulverized fuel, both in utility stations and in industrial plants, is increasing rapidly, and high efficiencies and ratings are being reached. A number of units are operating between 200,000 and 300,000 lb. of steam per hour. Automatic combustion control is giving valuable results. Stoker capacities are being increased to meet the demand for heat radiation per square foot of available space. Water-cooled walls are reducing stoker and furnace maintenance cost and slag trouble.

"Progress is reported in the commercialization of certain processes for the distillation of coal, and a number of plants are being established both in this country and abroad.. The most notable in this country is a plant near New Brunswick, N. J., operating on the K.G.S. system for the production of lump fuel and gas for domestic use, and tars and oils. The Standard Oil Company of New Jersey has obtained the American rights for the Bergin process covering the production of synthetic petrol.

"During the last year an agreement was made by representatives of the various public utilities, Red Cross, and government departments as to the proper methods to be adopted in resuscitation by the Prone Pressure Method. This method is presented in a pamphlet just published by the N.E.L.A. in conjunction with the American Gas Association and is applicable to gas poisoning, electrical shock and drowning.

"At present mechanical methods of producing respiration are definitely recommended against in electric shock cases. Nevertheless, because of the fact that new devices are constantly coming into the market, the N.E.L.A. jointly with the American Gas Association has set up a committee to study intensively and recommend on the use of all mechanical devices that may be offered for use in resuscitation.

The future will hold a job for everyone, if man takes advantage of Nature's willingness to co-operate, according to Dr. W. R. Whitney, Director of Electrical Research and Progress, of the General Electric Company Research Laboratory, Schenecetady, N. Y., who spoke at the general meeting on Wednesday morning.

"There is no sign of exhaustion of new raw materials, nor of scientific and constructive principles in an infinite universe. If there is anywhere failure to continue the advance in general welfare, whether in a material or in a purely spiritual sense, it will certainly be due to inappreciation or lassitude on our part rather than any deficiency in the limitless possibilities of Nature. If we control our fears and taboos, as now seems possible through more educated inquisitiveness, we may look forward to interesting occupations provided for everyone, mechanical work everywhere, but only for machines, and perhaps permanent world peace."

Industry in Market Place

A feature of the Friday morning general session was an address "The Power Industry in the Market Place," by James H. McGraw, President, McGraw-Hill Publishing Company, Inc. Mr. McGraw said, in part:

"Conditions are changing in the market place and the power company is beginning to face and feel the opposition of an aggressive and resourceful competition. I refer to the growing organized intercompetition between industries that is coming to be called the 'new competition.'

"At the present time in the neighborhood of 108 industries are engaged in concerted programs of co-operative promotion for the purpose of strengthening their positions in the market place, by securing the attention and developing the interests of the public.

"To put it bluntly, if I may, while so many of these other branches of industry have been so actively and cleverly holding the attention of the people, the electrical industry has stood, not mute in the market place, but it has not been able to make itself interesting.

"I would say that the power industry is spending entirely too little money for advertising to make a strong presentation of its product. Instead of the five million dollars or so which your Committee says was spent in the newspapers last year, I believe the appropriation should be not less than one per cent of the industry's gross income.

"I wonder if you are not making a mistake in talking too much to the public about the utility of electric service. Is not its luxury its most attractive feature to the rich and humble home alike?

"I have an abiding confidence, an increasing enthusiasm for the power industry. It has grown great in a service that has won the plaudits of the world. It has triumphed in invention, in engineering, in finance and in administration. It brings to the new problems of this oncoming commercial era resources that will carry over all obstructions. It will not fail to bring new honors in the market place."

Officers for the ensuing year elected on the last day of the convention are: President—P. S. Arkwright, Georgia Power Company, Atlanta, Ga.; vice-presidents—M. S. Sloan, Brooklyn Edison Company; W. A. Jones, Henry L. Doherty & Company; J. F. Owens. Oklahoma Gas & Electric Company; A. W. Thompson, United Gas Improvement Company; treasurer—P. S. Young, Public Service Electric & Gas Company.

Refrigeration Viewed from Many Angles At Detroit A.S.R.E. Meeting

Refrigeration Engineering Treated in Broad Way. Other Subjects Include Brine Composition, Fish Storage, Radiation, Thermodynamics and Evaporating Systems

IN RECOGNITION of the fact that domestic refrigerating equipment is rapidly becoming one of the important branches of refrigerating engineering the American Society of Refrigerating Engineers held its 1928 Spring Meeting at Detroit, Mich., the home of many household machine factories, from June 4 to 7.

After the preliminaries of registration, committee reports and routine organization work on the opening day, the engineers were presented with an extension of the orginal report of the Corrosion Committee by F. Fairbanks, one of the committee. It was reported that, contrary to the former view, there is little danger of "chromate itch" when using sodium dichromate in open brine tanks, the committee recommended this salt as a corrosion preventive where sodium-chloride brine is used.

In case of calcium-chloride brine it can be added at the rate of 100 lb. of the dichromate per 1,000 cu.ft. of brine. To this should also be added sufficient sodium hydroxide to convert the dichromate to the neutral chromate. It was suggested that the dichromate be placed in a bag and suspended in the tank close to the agitator.

To prevent corrosion of condenser stands, the addition of sodium silicate (water glass) should be made to the cooling water in plants where the water is put over a cooling tower for re-use. The chemical should be added until the water shows pink when tested with phenolphthalein. If the water comes in contact with corrosive industrial air, sodium dichromate should be added to make the water neutral. Where the condenser water is not recirculated, the chemical treatment is too expensive and the only protection is the painting of the piping.

In answer to an inquiry from a member, Mr. Fairbanks stated that in brine piping there was no advantage in galvanizing the inside of the pipe, but the outside needed galvanizing for appearance, and it was, moreover, cheaper to galvanize both sides. He stated that in the brine tanks he used no galvanized pipe and used bronze valves in all brine lines.

The opinion was offered that the corrosiveness of city water was due to the chlorination of the water supply. Free chlorine, uniting with the hydrogen in the air, formed hydrochloric acid.

Mr. Heilman on "Sukface Transmission"

The second paper of the Monday session was by R. H. Heilman, of the Mellon Institute, who spoke on "Surface Transmission." This paper dealt with the method employed by Mr. Heilman in determining the heat loss by radiation and convection. Essentially, the apparatus consisted of a radiation source covered with lampblack and a receiver consisting of a tin disk to the back of which was fitted 96 thermojunctions connected to a sensitive thermopile. The method was to measure the total heat dissipated by two surfaces at the same temperature and to determine the ratio of the radiations from the polished and the lampblacked surfaces.

At a dinner meeting on Monday the members were treated to a talk on "Rigid Air Craft," by V. R. Jacobs, who discussed the present developments in rigid air craft and spoke hopefully of the future possibilities.

Prof. C. H. Fessenden, University of Michigan, reintroduced the members to "Thermodynamics." In this he gave a résumé of thermodynamics as applied to engineering, especially that more or less puzzling phase of internal energy. This paper was thoroughly enjoyed, and will be published in full in a later issue of *Power*.

New Method of Fish Handling

The new method of handling fish was outlined by Harden F. Taylor, vice-president, Atlantic Coast Fisheries Company. In past days fish, after being unloaded from the boats, were frozen and shipped whole. These fish were then allowed to thaw before sale. If not cooked at once, unfavorable chemical changes set in, and it was not unusual for a loss of 50 per cent of a shipment to occur. It was also found that variation in temperature caused an increase in the ice crystals in the flesh cells, especially if the freezing had been done slowly.

Under the new process, upon being brought to shore the fish are dressed and the edible portions made up in cutlet or fillet form. These pieces of flesh are passed along a conveyor which is held at a low temperature by ribs on its lower side dipping into refrigerated brine. Each portion of the fish is wrapped in paraffined paper and placed in an air-tight container.

Shipment is made as far as 2,000 miles in refrigerated cars, which are kept at a low temperature by silica gel machines. Upon arrival at a destination the shipment is placed in cold storage and withdrawn as needed by the local markets. It is possible to keep fish in this way for months.

At present only haddock and cod are so handled, and no odors are given off to the storehouses. Such fish as smelts and mackerel may throw off odors, since they contain much fat. Warehouse odors are due to the unsaturated fats becoming rancid. It was the speaker's belief that refrigeration will permit a large increase in fish consumption in this country.

"Application of Refrigeration to the Oil Industry" was the subject of a paper by N. H. Hiller, Vilter Manufacturing Company. This dealt with the wide use of refrigeration in chilling the crude and processed oil to remove the paraffin wax. The author favored the compression machine for low-temperature work, a process of reasoning at variance with that of most engineers, who believe the absorption system shows up best at low temperatures. The author pointed out that there are possibilities as yet neglected for heat interchanging to reduce the load on the machines. At present about five tons of refrigeration capacity is needed for each 100 barrels of oil treated per day. This paper will be published in a later issue.

Probably the paper that awakened the greatest interest was one by Dr. H. T. Barnes, McGill University, on "Ice Engineering."

Dr. Barnes on "Ice Engineering"

Doctor Barnes' idea was to explain the cause of frazzil ice and to outline how ice jams could be eliminated. He stated that, contrary to the general belief, no great temperature difference was needed to cause ice to form; as small a change as 0.001 deg. F. would cause an alteration.

Steam, water and ice are by no means the same in molecular structure, and only steam has a structure of H_2O. Water should be written 2 (H_2O) and ice 3 (H_2O). Furthermore, Doctor Barnes claimed, in water at the boiling point there is 17 per cent of this trihydrol, or 3 (H_2O), and as the liquid grows colder the precentage increases.

Consequently, in cold running water, in which there is no external evidence of ice, the percentage of the trihydrol is large. As these "trihydrols" flow along, those in contact with the rock at the sides and bottom of the stream are attracted to the rock exactly as any two masses are mutually attracted. The result is that the trihydrol mass increases to the point where it becomes frazzil ice. This ice forms during the night and at the first light of dawn may receive enough radiant heat to produce a very minute temperature change—but sufficient to cause some of the 3 (H_2O) to change to the bihydrol 2 (H_2O). This permits the ice mass to break away from the river bed and rise to the surface.

The formation of ice on racks at a hydro power plant is due, so he stated, to a reversal of the action. The river water contains a large amount of 3 (H_2O) as individual molecules. At night there is a slight radiation from the water, and the resulting small temperature difference causes some of the 2(H_2O) to reform 3(H_2O), resulting in the congealing of the fluid into ice which collects around the racks. To eliminate this trouble only a small amount of heat need be applied, two 500-watt lights shining over a large ice rack are able to dislodge the entire ice mass. Consequently, to prevent ice formation at the plant intake, the speaker recommended the use of reflecting lights.

He described the thermite process he has developed to break up ice jams. In an ice jam, usually the solid surface ice rests upon an ice sludge. By burning thermite in the ice, this sludge becomes fluid and flowing down the stream opens a channel for the dammed-up river. The thermite explosion also breaks up the top ice which is usually under a high stress and needs the application of but a small additional force to cause it to fracture.

The same method has been used to break up icebergs. The speaker stressed the point that the heat added is not equal to the amount required to supply the latent heat of fusion of ice. It is only necessary to add enough heat to produce a slight temperature change. While the paper was on a subject somewhat remote from mechanical refrigeration, the action discussed by the speaker may explain the cause of bad can ice.

Modern Evaporating Systems

At the Wednesday session "Modern Refrigeration Evaporating Systems" was the subject of a paper by George Hilger. The speaker outlined in general the desirable characteristics of evaporating systems. It was pointed out that with the shell-and-tube evaporator the ammonia vapor leaving the evaporator was always superheated, the amount of superheat deperding upon the level of the liquid ammonia. A similar state of affairs exists in coils, and the speaker advocated the use of automatic control valves to regulate the level as well as regulate the coil pressure.

Control valves made by his company were then described and their operation explained. The three-pressure control system was recommended, in conjunction with a two-pressure compressor. The gas formed in a precooler is withdrawn through the flash gas valve to the high-pressure port of the compressor. The sub-cooled liquid from this cooler is led to the temperature-difference control valve on the evaporator, so that the flow of liquid is just sufficient to meet the refrigerating demands. This system is the multi-pressure system with automatic control features.

Other papers read were: "Double-Pipe Cooler and Condenser Tests," by F. C. Stewart; "Study of Heat Transmission in Refrigerator Cars," and several papers on domestic refrigeration.

Various social features on the program include a trip through the Ford Factory, auto trips about Detroit, bridge parties for the ladies and the annual banquet.

NEWS OF THE FIELD

The editors will welcome the co-operation of readers in reporting interesting happenings, personal or otherwise

Lake Trip Precedes A.S.M.E. Summer Meeting at St. Paul

THIS year's A.S.M.E. summer meeting will take place at St. Paul and Minneapolis, Aug. 27-30. Preceding the meeting a lake trip has been planned, which leaves Buffalo on Aug. 20. After stops at Cleveland, Detroit, Mackinack Island, the Soo Canal and Houghton, the boat will dock at Duluth on Aug. 25, where the local engineers are planning to reveal the mysteries of mining to the visiting mechanical men. From here the trip leaves for Winnipeg to enjoy the hospitality of the Winnipeg branch of the Engineering Institute of Canada. The excursion will arrive at St. Paul on Monday, Aug. 27.

The headquarters of the meeting will be at the St. Paul Hotel, where all the technical sessions will be held and a portion of the entertainment events. Monday morning will be given over to the council meeting, technical sessions will be held in the afternoon, and in the evening there will be an informal entertainment at the hotel. Technical sessions will be held Tuesday, Wednesday and Thursday mornings, leaving the afternoons free for visits. On Tuesday afternoon it is planned to visit the industrial plants of Minneapolis, while on Wednesday afternoon the industries of St. Paul will be thrown open to the visiting engineers.

The technical program will be made up of papers that are on hand June 15, and sessions are planned on applied mechanics, apprenticeship training, aëronautics, fuel, agricultural engineering, power, Iron Range mining, flour milling, research and paper manufacture.

The outstanding program event will be a dinner on Wednesday evening at the St. Paul Hotel, at which Thomas B. Campbell, of Hardin, Montana, and Ralph G. Budd, president of the Great Northern Railway, will be the speakers. Mr. Campbell is a graduate engineer and operates a farm of 95,000 acres on the same basis as a great industry. Mr. Budd is recognized as a great industrial leader of the Northwest, and his address will be of interest.

Puget Sound Power & Light Awarded Coffin Medal

The Puget Sound Power & Light Company, of Seattle, which furnishes electricity to the State of Washington and to the Northwest, has been awarded the Charles A. Coffin Foundation gold medal for its outstanding achievements during 1927. The award was announced by H. T. Sands, president of the National Electric Light Association in convention at Atlantic City, June 6. It is the fifth annual award of the medal, made possible through the creation of the Charles A. Coffin Foundation in 1922, honoring the memory of the General Electric Company's founder.

President Sands spoke in glowing terms of the many accomplishments of the Puget Sound Company, declaring "it had practically left nothing undone in extending its business in all branches of activity."

The company was one of the first to enter into the field of rural electrification. Out of 40,000 farms in the company's territory, 63 per cent are electrified.

While the population served by the company's lines increased slightly more than 5 per cent, a gain of more than 10 per cent was made in the number of customers served. This was closely paralleled by a gain in total energy sold of nearly 12 per cent. The average kilowatt-hours used per customer rose from 650 to 763 among its resident customers, numbering more than 100,000.

In the field of engineering the company has also done many notable things. Because of the importance of the fishing industry, high-head plants on spawning streams have been seriously opposed, since fish ladders had been successful only up to 50 ft. In 1927 the company completed the design and construction of a fishway operating at 290 ft. The dam at that plant was raised from 260 to 290 ft., while in operation.

The company, according to Mr. Sands, claims to have been the first, in 1918, to solve the problem of burning pulverized fuel. It still has the largest installation in its section of the country.

With the medal was a check for $1,000 from the Charles A. Coffin Foundation for the employees' benefit association of the Puget Sound Company. Both the medal and check were received in behalf of the company by A. W. Leonard, president.

Three other companies were mentioned as having done outstanding work during the past year. They were the Duquesne Light Company of Pittsburgh, the Public Service Electric and Gas Company of New Jersey, and the Union Gas and Electric Company of Cincinnati. The committee of awards, in addition to President Sands, is composed of Dr. S. W. Stratton, president of Massachusetts Institute of Technology, and R. H. Ballard, president of the Southern California Edison Company.

N.D.H.A. to Hold Annual Convention at Atlantic City

The annual convention of the National District Heating Association is to be held June 12 to 15 at the Ambassador Hotel, Atlantic City, N. J. The president of the association, Charles A. Gillhan, New York Steam Corporation, will open the convention Tuesday, June 12, at 2 p.m. Reports from several of the committees will be followed by an address by Walter H. Johnson, Philadelphia Electric Company. On Tuesday evening A. J. Slade, of the American District Steam Company, will present a paper on the "Manufacturers' Division and Its Work," and an illustrated paper on "District Heating Progress." The Operating Statistics Committee will present its report Wednesday morning, after which H. D. Liversidge, Philadelphia Electric Company, will address the convention. After the address a paper, "Putting a Hot Water System in Black Ink," by Stephen Delaney, of the Atlantic City Electric Company, will be presented.

Thursday and Friday morning various committee reports will be presented. Of particular interest will be the report by the Station Operating Committee, to be presented Friday morning.

According to the usual custom, a manufacturers' round-table will be held following each technical session.

Canada Launches a Diesel Tug

The most powerful Diesel-engined tug in Canada, the "George M. McKee," owned by the Anticosti Corp., was recently launched from the Davie shipbuilding yards at Lauzon, Quebec.

The Fairbanks Morse Diesel engine installed in the tug is of the vertical, two-cycle, airless-injection type, and develops 700 b.hp. at a speed of 250 r.p.m. This engine, which has six 16 x 20-in. cylinders, is designed for heavy duty; all working parts are fully enclosed.

All accessories necessary for the operation of the engine such as compressor, main circulating oil pump, water cooling pump, bilge pump, and oil transfer pump are built into the engine, making it a self-contained unit

capable of operating without the aid of outside auxiliaries.

The electrically driven auxiliaries will be handled by a 36-kw. generator direct connected to a 60-hp. Fairbanks Morse Diesel. There is an auxiliary 9-kw. generator driven by a Kromhaut semi-Diesel engine and seated aft on the main deck.

America Contributes Papers to London Fuel Conference

Many of the American engineering organizations have pledged themselves to participate in the World Power Fuel Conference to be held at the Imperial Institute, London, Sept. 24 to Oct. 6. At this meeting problems relating to all types of fuel will be discussed in papers furnished by many countries.

The British Committee has published a program that shows in detail the complete scope of subjects to be considered at the meeting.

Our participation in the program will include papers on thirteen different topics. These papers are now being prepared under the auspices of various engineering organizations as outlined in the following program:

Coal Cleaning—American Institute of Mining and Metallurgical Engineers.

Production of Solid Smokeless Fuels whether by means of Low-Temperature Carbonization or by means of an Improved Coke—U. S. Bureau of Mines.

Production and Utilization of Powdered Fuel in the Metallurgical Industry and for Steam Raising—American Institute of Mining and Metallurgical Engineers.

Shale and the Production of Oil from Shale—U. S. Bureau of Mines.

Oil Cracking—U. S. Bureau of Mines, American Institute of Mining and Metallurgical Engineers.

Coke Oven Practice and Developments in Bulk Carbonization—American Institute of Mining and Metallurgical Engineers.

Long Distance Gas Distribution—American Gas Association.

Domestic Heating by Means of Solid Fuel, Oil, Gas and Electricity—U. S. Bureau of Mines and others.

Utilization of Electricity for Industrial Heating—National Electric Light Association, American Institute of Electrical Engineers, American Welding Society, American Electrochemical Society, American Chemical Society.

Utilization of Gaseous Fuels in Industrial Furnace Work—American Gas Association, American Society of Mechanical Engineers, American Society for Steel Treating, American Society of Heating & Ventilating Engineers.

Waste Heat Recovery—American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers.

Production and Utilization of Producer Gas in Industry—American Institute of Mining and Metallurgical Engineers.

Basis of Evaluation of Fuel Resources—U. S. Bureau of Mines.

Power Commission Suspends Issuance of Licenses

The Federal Power Commission, at its meeting of May 28, ordered that no application for license shall be presented to the commission for its approval until an agreement has been reached by the applicant with the commission relative to the valuation of the properties affected. Suspension of the commission's activities in regard to water-power licenses was brought about by the failure of Congress to provide by legislation the commission with adequate personnel to carry on its work properly, according to reports from Washington.

In addition, the commission ordered that all preliminary permits shall contain a requirement that the permittee shall, with its applications for license, submit under oath a statement showing the items and the total amount claimed by the applicant as the actual legitimate cost of the project applied for at the date of application or at a date not more than 30 days prior thereto.

Since its creation in 1920 the Federal Power Commission has issued 290 licenses involving an estimated installation of 6,357,000 hp. Since the Federal Water Power Act, 92 projects have been placed under construction, involving costs of probably not less than $655,000,000. Projects under license and not yet under construction involve not less than $300,000,000 more. Out of this total the commission has reached settlement of values or cost aggregating $21,000,000 and has wholly or partly examined claims aggregating $100,000,000 more. As this is the result of seven years' work, the task still ahead of the commission is evidently considerable.

Two Old Timers Still Going Strong

Photo Courtesy G. E. Co.

This Edison bipolar generator, rated at 45 kw., 125 volts, has been installed in the plant of Yund, Kennedy & Yund, Amsterdam, N. Y., since 1890. William Floyd, whose picture is shown, has been in charge of this machine since its installation, and the pair are still on the job furnishing lights to the factory. If the switchboard instruments, which are evidently of the same age as the generator, may be trusted, the present load is nearly 50 kilowatts.

I. E. C. Advisory Committee Considers Turbine Test Code

During the week of May 20 the Steam Turbine Advisory Committee of the International Electrochemical Commission held at The Hague, Holland, a most successful meeting at which it attempted to reconcile the various test codes for steam turbines now used throughout the world and to develop a standard code for international adoption. The meeting was truly international in character, eight nations being represented by 23 delegates.

The United States was represented at the meeting by I. E. Moultrop, chief engineer and assistant superintendent, Construction Bureau, Edison Electric Illuminating Company of Boston, and Francis Hodgkinson, consulting mechanical engineer, Westinghouse Electric & Manufacturing Company. C. B. LePage, assistant secretary, A.S.M.E., also attended the meeting as Assistant Director of the Secretariat to the Advisory Committee.

Advance Survey of Boulder Dam Authorized by Congress

On May 28 the Senate and the House of Representatives authorized the Secretary of the Interior to appoint a board of five engineers for the purpose of conducting a preliminary survey of the Boulder Dam project as proposed in the Swing-Johnson bill. The board is to determine matters affecting the safety, the economic and engineering feasibility, and adequacy of the proposed structure and incidental work. The resolution also provides that the construction of the dam shall be deferred until such plans are approved by the board.

In an amendment to the resolution the appointment of the board was made subject to the approval of the President. The board is to consist of five eminent engineers and geologists, at least one of whom shall be an engineer officer of the army on active or retired list.

Personals

Fred A. Scheffler, of the Fuller Lehigh Company, New York, and Mrs. Scheffler, are celebrating their 43rd wedding anniversary by a trip abroad on the Steamship "President Wilson." They will visit the important centers of Europe and will return to New York about July 10 on the "George Washington."

Dr. Walter Cross has become associated with The Babcock & Wilcox Company as consulting chemical engineer. While his duties will necessitate his spending some time in New York, he will make his headquarters in Kansas City as heretofore.

James W. Carey, chief valuation engineer of the State Tax Commission of Washington, has resigned to become associated with Kenneth G. Harlan, public-utility expert, of Tacoma. A firm of public-utility consultants has been formed under the name of Harlan, Carey & Company.

W. D. Philips, formerly sales engineer with the Drying Systems, Inc., has become vice-president of the Nichols Products Corporation, New York City.

J. H. Flynn, until recently with the Milliken Bros.-Blaw Knox Corporation, New York, has become associated with the General Electric Company in its branches in Peru and Argentina.

Coming Conventions

American Institute of Electrical Engineers, annual Summer convention at Denver, Colo., June 25-29; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Order of Steam Engineers, convention at Atlantic City, N. J., June 11-14, and exhibition with American Supplymen's Association. Address Fred L. Jahn, Watson of McDaniel Company, 146 N. Seventh St., Philadelphia.

American Society of Heating and Ventilating Engineers, Summer meeting at West Baden Springs Hotel, West Baden, Ind., June 26-29; A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers, first national oil and gas power meeting at State College, Pa., June 14-16; Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3; second national fuels meeting at Cleveland, Ohio, Sept. 17-20; Calvin Rice, secretary, 29 West 39th St., New York City.

American Society for Testing Materials, Atlantic City, June 25-29.

American Water Works Association. Annual meeting, Hotel Fairmont, San Francisco, June 11-16; W. M. Niesley, 170 Broadway, New York City.

Association of Iron and Steel Electrical Engineers, annual convention and Iron and Steel Exposition at Hotel Stevens, Chicago, June 25-29.

Canadian Steel and Power Show at the University of Toronto Arena, Sept. 4-7; Campbell Bradshaw, secretary, 24 Front St., West Toronto, Canada.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago. New England States Association convention at Hartford, Conn., June 21-23; K. W. Lundberg, secretary. Foot Guard Armory, Hartford.

National Board of Boiler and Pressure Vessel Inspectors, meeting at Erie, Pa., June 18-20.

National District Heating Association, annual meeting at Ambassador Hotel, Atlantic City, June 12-15; D. J. Gaskill, sec., 112 West 4th St., Greenville, Ohio.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Universal Craftsmen Council of Engineers, Newark, N. J., Aug. 7-10.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

Business Notes

The Westinghouse Electric & Manufacturing Company recently appointed Samuel A. Curry as superintendent of inspection and test at the South Philadelphia Works. Mr. Curry, who was field engineer and turbine test engineer, assumes the position made vacant by the recent accidental death of John T. Snyder. Mr. U. A. Taddiken, formerly a member of the condenser engineering department, was appointed to the position made vacant by Mr. Curry.

The Midwest Locomotive Works, Cincinnati, Ohio, has recently been taken over by the owners of the Columbia Machine Tool Company and the Ceramic Machinery Company, and has recently been moved to Hamilton, Ohio, where locomotives from 3 tons to 15 tons capacity will be manufactured from de-

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except **Pittsburgh gas slack:**

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.35@$2.60
Kanawha	Columbus	1.25@ 1.60
Smokeless	Cincinnati	1.75@ 2.00
Smokeless	Chicago	1.65@ 2.00
S. E. Kentucky	Chicago	1.35@ 1.75
Steam	Pittsburgh	1.40@ 1.80
Gas Slack	Pittsburgh	1.15@ 1.25
Big Seam	Birmingham	1.40@ 1.75
Anthracite (Gross Tons)		
Buckwheat	New York	$2.75@$3.00
Birdseye	New York	1.60

FUEL OIL

New York—June 7, 28@34 deg., Baumé, industrial use, tank-car lots, 5c. per gal.; 36@40 deg., furnace, tank-car lots, 7c. per gal., f.o.b. Bayonne, N. J.

St. Louis—June 1, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.50 per bbl.; 26@28 deg., $1.55 per bbl.; 28@30 deg., $1.60 per bbl.; 30@32 deg., $1.65 per bbl.; 32@36 deg., gas oil, 4.3c. per gal.; 38@40 deg., 4.98c. per gal.

Pittsburgh—May 31, f.o.b. local refinery, 30@34 deg., fuel oil, 5¼c. per gal.; 36@40 deg., 5½c. per gal.

Philadelphia—June 7, 26@30 deg., $2.07 per bbl.; 13@19 deg., $1.22 per bbl.; 22 plus, $1.48@$1.55 per bbl.; 27@30 deg., $2.17 per bbl.

Cincinnati—May 29, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—June 2, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 80c. per bbl.; 26@30 deg., 85c. per bbl.; 30@32 deg., $1.02½@$1.05 per bbl.

Boston—June 4, tank-car lots, f.o.b. 12@14 deg. Baumé, 4½c. per gal.; 28@32 deg., 5.65c. per gal.

Dallas—June 2, f.o.b. local refinery, 26@30 deg., $1.30 per bbl.

signs heretofore built in Cincinnati. Larger sizes will be added to the line at an early date. Repairs for the Burton friction drive locomotives formerly built by The Burton Company, the predecessor of the Midwest Locomotive Works, will be furnished as heretofore.

THE PEABODY ENGINEERING CORPORATION, 110 East 42nd St., New York City, has increased its engineering personnel and has leased additional space at its New York office. Mr. Peabody, who is president of the company, has returned from a month's business trip in Europe, where he studied the different methods of firing pulverized coal, oil and gas in England, France and Germany.

BOTFIELD REFRACTORIES COMPANY, Swanson and Clymer Sts., Philadelphia, Pa., announces that, effective June 1, the distribution of its Adamant firebrick cement, Adachrome and the Adamant gun, for Toledo, Ohio, and vicinity will be handled by The Builders & Industrial Supply Company, 4090 Detroit Street, Toledo, Ohio.

THE BOSTON WOVEN HOSE & RUBBER COMPANY, Boston, has announced the appointment of A. C. Kingston as assistant general manager in charge of sales and a member of the board of directors. J. W. Fellows, factory manager, has also been elected to the board of directors.

TRADE CATALOGS

HERRINGBONE GEARS — The W. A. Jones Foundry & Machine Company has just issued a 24-page booklet describing an improved method of generating herringbone gears. It shows tooth forms, dimensions, price lists in cast iron and steel for recommended face widths, and horsepower tables for open gearing.

LOW-SPEED SYNCHRONOUS GENERATORS—The General Electric Company, Schenectady, N. Y., has available a four-page bulletin No. GEA-383B, describing its machines of this type with welded frames. These machines are for direct connection to steam and internal-combustion engines.

TOTALIZING RECORDING INSTRUMENTS AND REMOTE INDICATORS—The General Electric Company, Schenectady, N. Y., has recently issued an eight-page catalog No. GEA-584A on its totalizing wattmeter recorders and indicators. With this equipment, when it is desired to transmit the totalized reading to remote parts of the plant, the totalizer is equipped with Selsyn motors.

UNIT PULVERIZER—The Grindle Fuel Equipment Company, Harvey, Ill., has issued Bulletin No. 9 describing the mechanical features and principles of operation of its multi-stage unit pulverizer. In this pulverizer the grinding elements consist of a series of swinging hammers mounted in stages on a vertical shaft, the rotor being direct connected to a vertical motor mounted on the top of the machine.

THE ELLIOTT COMPANY, Jeanette, Pa., has just issued bulletins Nos. H-3, H-4 and H-5, covering the Elliott forms BP, CP and DP turbines for mechanical drive. The bulletins are printed in two colors and contain views of the turbines.

CONTROL VALVES AND GOVERNORS—In bulletin No. 103, just issued by the Hagan Corporation, 304 Ross St., Pittsburgh, a number of special control valves and governors are described in detail. Included in the line of regulators covered in the bulletin are roto-reciprocating valve, special stoker governor, Venturi and dual butterfly valves, master-pilot, hydraulic control, and chemical control valve.

SPEED RECORDERS—The Esterline-Angus Company, Indianapolis, Ind., has recently issued a new eight-page bulletin, No. 328, that describes its new speed recorder and a number of applications for these recorders. Among the applications are paper machines, on board ship, on steam turbines, in cement mills and on waterwheels.

NEW PLANT CONSTRUCTION

Compiled by the McGraw-Hill Business News Department, which is prepared to furnish a more complete daily service to those who wish it

Calif., Eagle Rock — Occidental College, R. D. Bird, Pres., plans the construction of a group of college buildings. Estimated cost $1,000,000. M. Hunt and H. C. Chambers, Hibernian Bldg., Los Angeles, Archts.

Calif., San Jose—Union Ice Co., 354 Pine St., San Francisco, awarded contract for an ice manufacturing plant on Wilson Ave. here, to W. W. Williamsen, 320 Market St., San Francisco. Estimated cost $200,000.

Ill., Chicago—Plotke & Grosby, 111 West Washington St., are having plans prepared for a 16 story apartment building at 5232-42 Sheridan Rd. Estimated cost $3,000,000. Huszagh & Hill, 6 North Michigan Ave., are architects.

Kan., Wichita — Bd. of Education, L. Gerteis, Secy., awarded contract for the construction of a boiler plant, etc. for high school to Connor Construction Co., 1020 McGee St., Kansas City, Mo. Estimated cost $234,988.

Kentucky—Kentucky Utilities Co., M. E. Taylor Bldg., Louisville, has made application to the Federal Power Commission to construct a hydro-electric plant on the Kentucky River to include power houses at U. S. dams and locks, 4, 5, 6 and 3, also transmission lines to connect existing system and that of Kentucky Hydro-Electric Co. Estimated installed capacity is 11,280 cu. sec. ft.

Ky., Paducah — City is having surveys made for the construction of a municipal electric light plant. Estimated cost $800,000. Burns & McDonnell, 401 Interstate Bldg., Kansas City, Mo., are engineers.

Mass., Salem—Owner, c/o York Ice Machinery Corp., 200 Causeway St., Boston, Engr., is having plans prepared for the construction of an ice plant on Franklin St. here. Estimated cost $100,000.

Minn., Minneapolis—Abbott Hospital, B. Anderson, Bus. Mgr., 1717 First Ave. S., will readvertise for bids soon for a 5 story addition to hospital, including steam heating and refrigeration systems, etc., at 17th St. and First Ave. S. Estimated cost $600,000. Magney & Tusler, 116 South 9th St., are architects.

Mo., Stanberry—City voted $40,000 bonds for the construction of a municipal lighting system, power house, etc. Henrici-Lowry Engineering Co., 402 Security Bldg., Kansas City, is engineer.

Neb., Gering — Union Pacific R.R. Co., 15th and Dodge Sts., Omaha, will receive bids until June 15 for construction of a boiler house, pump house, etc., here. Estimated cost $150,000. G. J. Adamson is chief engineer.

N. Y., Albany—National Savings Bank, F. B. Stevens, 72 State St., is having plans prepared for a 20 story bank and office building at 90-94 State St. Estimated cost $1,500,000. Halsey, McCormack & Helmer, 286 5th Ave., New York, are architects.

N. Y., Albany—State Dept. of Charities awarded contract for the construction of St. Peters Hospital and Bishop Cusack Memorial on New Scotland Ave., to John P. Sewell, 372 Hudson Ave. Estimated cost $1,250,000.

N. Y., Brooklyn — Shoreview Building Corp., J. Leibonitz, Pres., had plans prepared for two 6 story apartment buildings at Ridge Blvd. and 75th St. Estimated cost $1,000,000. Cohn Bros., 361 Stone Ave., are architects.

N. Y., Buffalo—H. J. Cook, 438 Delaware Ave., Archt., awarded contract for an apartment building at Main and Balcom Sts. to Gilsam Construction Corp., 1357 Hertel Ave. Estimated cost $500,000. Owner's name withheld.

N. Y., Long Island City—D. Becker, 5215 15th Ave., Brooklyn, had plans prepared for the construction of a group of apartment buildings at 34th Rd. and 94th St. Estimated cost $900,000. Malkind & Weinstein, 93 Court St., Brooklyn, are architects.

N. Y., New York—Central Park West Corp., I. Kraft, Pres., 1560 Broadway, had plans prepared for a 16 story apartment building at 2 West 95th St. Estimated cost $1,000,000. J. M. Felson, 250 West 57th St., is architect.

N. Y., New York—G. W. Building Corp., S. Glass, Pres., 986 Forest Ave., had plans prepared for a 5 story apartment building at Devoe, Wyatt to 177th Sts. Estimated cost $1,000,000. Schaefer & Rutkins, 2408 Grand Concourse, are architects.

N. Y., New York—Jewish Memorial Hospital, Dyckman St. and River Rd., will soon receive bids for the construction of a 9 story hospital at 4614 Broadway. Estimated cost $1,400,000. C. B. Meyers, 31 Union St., is architect.

N. Y., New York—Lenox Hill Hospital, Park Ave. and 77th St., is having preliminary plans prepared for a hospital. Estimated cost $2,000,000. York & Sawyer, 100 East 42nd St., Archts.

N. Y., New York—Ralston Realty Co., D. Greenberg, 213 West 35th St., plans the construction of a 10 story apartment building at 182nd St. and Grand Concourse. Estimated cost $1,000,000. Bark & Djorup, 1351 Broadway, are architects.

N. Y., New York — Rhoades-Kennedy Corp., 342 Madison Ave., awarded contract for a 14 story apartment building at 84th St. and Park Ave. to T. E. Rhoades Co., 342 Madison Ave. Estimated cost $1,500,000.

N. Y., New York — Julius Tishman & Sons, 285 Madison Ave., is having preliminary plans prepared for a 15 story apartment building at 42-56 Sutton Pl. Estimated cost $4,000,000. Architect not selected.

N. Y., New York—Voorhees, Gmelin & Walker, 101 Park Ave., Archts., will receive bids about July 2 for the construction of a hotel and club building at 125 West 13th St., for Salvation Army. Estimated cost $2,000,000.

N. Y., Poughkeepsie — Dept. of Mental Hygiene, Capitol, Albany, awarded contract for the construction of a power house for Hudson River State Hospital here, to Carder Realty Corp., 1476 Broadway, New York. Estimated cost $157,750.

N. Y., St. George—St. George Gardens, Inc., 26 Court St., Brooklyn, will build an apartment building at St. Marks Pl. and Westervelt Ave. Estimated cost $1,200,000. S. Gardstein, 44 Court St., Brooklyn, is architect. Work will be done by separate contracts.

N. C., Vass—City, W. D. Matthews, Mayor, will receive bids until June 12 for the construction of a new water supply system including deep well pump house, etc. Carolina Engineering Co., 917 Johnston Bldg., Charlotte, is engineer. G. R. Bishop, is consulting engineer.

O., Cleveland—The Shaker Co., c/o O. P. & M. J. Van Sweringen, Terminal Tower, awarded contract for a group of store and office buildings on Moreland Circle to Crowell & Little Construction Co., Hanna Bldg. Estimated cost $1,500,000.

O., Columbus—Dept. of Welfare, J. E. Harper, Dir.. Ninth and Oak Sts., is having plans prepared for a 98 x 105 ft. power house on West Broad St. Estimated cost $70,000.

O., Kent—Bd. of Trustees, Kent Normal School, is receiving bids for remodeling heating plant. Estimated cost $35,000. Glass & Ramsey, 186 East Broad St., Columbus, are engineers.

O., Marietta—Bd. of Trustees, Marietta College, A. H. Savenye, Financial Secy., will receive bids until June 13 for remodeling central heating plant. Estimated cost $60,000. Glass & Ramsey, 186 East Broad St., Columbus, are engineers.

Okla., Frederick — City is having preliminary plans prepared for the construction of a 2,000 hp. Diesel engine electric light plant. Estimated cost $200,000. J. Zunwalt, is engineer.

Ore., Grants Pass—C. H. Lee, San Francisco, Calif., and R. W. Myers, Bacon Bldg., Oakland, Calif., have made application to the Federal Power Commission to construct power plants 3, 4-5 on the Rogue River in Josephine County.

Pa., West Chester — Borough of West Chester, P. MacElree, Pres., will receive bids until June 13 for the construction of a filtration plant and pumping station. Estimated cost $85.000. T. G. Colesworthy, Court House, is consulting engineer.

Tex., Corpus Christi—Smith Bros. Nixon & Associates, awarded contract for a 12 story hotel to McKenzie Construction Co., c/o Travis Bldg., San Antonio. Steam heating and refrigeration systems, elevators, etc. will be installed.

Tex., Cuero—Central Power & Light Co., Frost Bldg., San Antonio, has been granted permit to construct a hydro-electric power dam, 35 ft. high and 300 ft. long on the Guadalupe River near here. Private plans.

Tex., Houston—San Jacinto Athletic Club, 1113 Esperson Bldg., plans the construction of an 8 story club building at Main and Francis Sts. Estimated cost $1,000,000. J. Finger, Democratic Bldg., Archt.

Tex., Littlefield—Littlefield College, c/o R. O'Connor, Bus. Mgr., will build a group of college buildings including power plant, etc. by day labor. Estimated cost $500,000.

Tex., Port Arthur—J. F. Goodhue, 901 Goodhue Bldg., Beaumont, plans the construction of an 11 story hotel including vapor vacuum heating system, etc. here. Estimated cost $550,000. Tisdale, Stone & Pinson, 1103 Goodhue Bldg., Beaumont, are architects.

Tex., San Angelo—B. B. Hall, will receive bids until June 15 for the construction of a 12 story hotel including steam heating, ventilation and refrigeration systems, boilers, elevators, etc. Estimated cost $750,000. B. M. Morgan, San Angelo National Bank Bldg., is architect.

Tex., San Antonio—Smith Bros. Properties, Inc., J. W. Young, Plaza Hotel, is having preliminary surveys made for the construction of a waterworks system including deep wells, pumping system, distribution lines, etc. Estimated cost $35,000. Terrell Bartlett, Engrs., Calcasieu Bldg., are engineers.

Va., Richmond — Broad-Grace Arcade Corp., R. T. Barton, Jr., Pres., c/o Carneal & Johnston, Electric Bldg., Richmond, Va., Archts., is having plans prepared for a 25 story office building at Third and Grace Sts. here. Estimated cost $1,500,000. I. J. Eberson, 200 West 57th St., New York, N. Y., is associate architect.

Va., Richmond—Rosewood Construction Co., P. J. Beattie, Pres., American National Bank Bldg., plans the construction of a 6 story hotel on Cary St. Rd. Estimated cost $1,000,000. W. D. Lee, Travelers Bldg., is architect.

Man., Winnipeg—Dept. of Public Works, S. E. O'Brien, Secy., Ottawa, Ont., will receive bids until June 26 for alterations and additions to heating plant here.

Ont., Ottawa—Hampson Frost & Co., Toronto, is having plans prepared for a 10 story hotel on Metcalfe St. Estimated cost $2,000,000 to $2,500,000. Lockwood, Greene & Co., 100 East 42nd St., New York, N. Y., are engineers.

Que., Montreal—Revenue Realties, Inc., awarded contract for the construction of a 10 story apartment building on Sherbrooke St. W. Estimated cost $3,000,000.

Equipment Wanted

Boilers — Dept. of Mental Hygiene, Capitol, Albany, N. Y., will receive bids until July 27, for new boilers, etc. at Brooklyn State Hospital, Brooklyn, N. Y.

Boilers, Engines, Etc.—Dept. of Welfare, Ninth and Oak Sts., J. E. Harper, Dir., Columbus, O., plans to purchase equipment including boilers, engines, etc. for proposed power plant.

Boilers, Stokers, Etc. — H. J. Heinz Co., 1062 Progress St. N. S., Pittsburgh, Pa., plans to purchase new boilers, stokers, etc. for proposed addition to power plant at Leamington, Ont. Estimated cost $50,000.

Coal Handling Equipment — City Ice & Fuel Co., E. Balzhazer, V. Pres., 6611 Euclid Ave., Cleveland, O., plans to purchase coal handling equipment for proposed ice plant. Estimated cost $70,000.

Electrical Equipment, Etc.—Dept. of Railways & Canals, West Block, Ottawa, Ont. J. W. Pugsley, Secy., will receive bids until June 26 for the manufacture and delivery of electrical equipment and operating machinery for lock gats, taintor valves, regulating wires and gateyard on Welland Ship Canal, Welland, Ont.

Engine, Transformers, Etc. — City of Stanberry, Mo., plans to purchase an oil engine, transformers, etc. for proposed lighting system.

Pumping Equipment—G. A. Gross, Clk., Oakland, Calif., will receive bids until June 18, for furnishing and installing pumping equipment in Oakland-Alameda Estuary tube portal buildings and in Segment D, Estuary subway.

Pumping Unit—E. C. Scales, Mississippi National Guard, Vicksburg, Miss., will receive bids until June 12, for the installation of a pumping unit for proposed pump and power house.

Pumping Units — Commission Council, Baton Rouge, La., will receive bids until June 26, for two 2,500 g.p.m. sewage pumping units with auxiliary equipment, etc. for proposed sewage improvements.

Pumps, Etc.—Bd. of Council, Fair Lawn School No. 3, Fair Lawn, N. J., will receive bids until June 16, for electric centrifugal pumps, etc. for proposed waterworks system. Estimated cost $500,000.

Pumps, Etc. — Cameron County Water Control & Improvement Dist. 7, H. H. Banker, Pres., Brownsville, Tex., plans the installation of two 24 in. 11,250 g.p.m. electrically driven pumps for proposed irrigation improvements.

Pumps, Etc. — City of Portsmouth, C. Stevenson, Engr., will soon receive bids for pumps and equipment for proposed improvements to waterworks.

Refrigeration Equipment—Dept. of Mental Hygiene, Capitol, Albany, N. Y., will receive bids until June 27, for refrigeration equipment at Letchworth Village, Theills, N. Y.

Refrigeration Equipment—Dept. of Mental Hygiene, Capitol, Albany, N. Y., will receive bids until June 27, for refrigeration equipment, etc. at Utica State Hospital, Utica, N. Y.

Refrigeration and Ice Making Equipment—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until June 20, for complete refrigeration and ice-making equipment, etc. at Naval Air Station, Lakehurst, N. J.

Switchboard Equipment, Oil Burning Equipment, Etc. — Hot Springs Public Utilities, S. E. Dillon, Gen. Mgr., 915 Central St., Hot Springs, Ark., plans to expend $40,000 for extensions and improvements including switchboard equipment. reserve oil burning equipment, etc.

Industrial Projects

Calif., Los Angeles—ASSEMBLY PLANT—Willys-Overland Co., c/o J. A. Sheldon, 439 Biltmore Hotel, awarded contract for a group of 1 story plants to J. V. McNeil Co., 5860 Avalon Blvd. Estimated cost $600,000.

Conn., Bridgeport—FACTORY—General Electric Co., Boston Ave. and Bond St., will build a 2 story, 42 x 62 ft. factory on Boston Ave. Estimated cost $40,000. Private plans.

Kan., Wichita—PACKING PLANT—F. Dold & Son plans the construction of a packing plant. Herscheim & McClaren, Chicago, Ill., are architects.

Ky., Louisville—TOBACCO FACTORY—Tobacco By-Products & Chemical Corp., Columbus Bldg., awarded contract for the construction of a 60 x 360 ft. factory, 49 x 52 ft. power house, 40 x 80 ft. machine shop, etc., at 17th and Magnolia Sts. J. E. Sirrine & Co., 309 South Main St., Greenville, S. C., are engineers.

La., Buras—PACKING PLANT—Buras Orange Growers, Inc., is receiving bids for a 1 story, 175 x 225 ft. packing plant. Estimated cost $40,000. Private plans.

Mich., Ferndale — SHEET METAL and TUBE PLANT — Steel & Tube Co., Inc., 224 East 131st St., Cleveland, O., plans the construction of a 1 and 2 story sheet metal and tube plant on Nine Mile Rd. Estimated cost $500,000. Private plans.

N. J., Kearny — ELECTRIC MANUFACTURING PLANT — Western Electric Co., 195 Broadway, New York, N. Y., had plans prepared for a 6 story, 200 x 300 ft. plant Central Ave. and Lincoln Highway, here. Estimated cost $1,250,000. Private plans.

N. Y., Long Island City—STEEL PLANT—Bayonne Steel Co., M. Katz, 223 West 19th St., New York, awarded contract for the construction of a plant at School St. and Anable Ave. here, to Wilcox Construction Corp., Bridge Plaza, Long Island City. Estimated cost $80,000.

O., Akron — LAMP FACTORY — Akron Lamp Co., 600 South High St., plans a 2 story, 60 x 70 ft. factory. Estimated cost $40,000.

O., Cleveland — TERMINAL — Cleveland Union Terminal Co., C. L. Bradley, Pres., Terminal Tower Bldg., awarded contract for a 3 story, 486 x 960 ft. main station building at Public Sq. to Aronberg-Fried Co., 29 East 40th St., New York, N. Y. Estimated cost $5,500,000.

O., Cleveland — FOUNDRY — Ohio Foundry Co., H. Trenkamp, Secy. and Treas., 9806 Quincy Ave., had plans prepared for a 1 story, 150 x 200 ft. factory at 9608 Quincy Ave. Estimated cost $100,000. Carter-Richards Co., Engineers Bldg., is architect.

Texas — GASOLINE REFINERY — Phillips Petroleum Co., Bartlesville, Okla., plans the construction of a gasoline refinery on Rock Creek in Hutchinson County, here. Estimated cost $150,000. Work will be done by company forces.

Tex., D'Hanis—OIL and GAS REFINERY—Golden West Oil Co., Hondo, will build an oil and gas refinery in Ina fields in Medina county, near here. Estimated cost $75,000. Private plans.

Tex., San Antonio—CEMENT PLANT—Smith Bros. Properties, Inc., J. W. Young, V. Pres., Plaza Hotel, is having plans prepared for the construction of a plant on Austin Highway. Estimated cost $2,000,000. Terrell Bartlett, et al., c/o Calcasieu Bldg., are engineers.

Va., Roanoke — CHEMICAL PLANT — Stauffer Chemical Co., A. Walter, V. Pres., Grand Central Terminal, New York, N. Y., has acquired a site near Ampthill and plans the construction of a factory for the manufacture of chemicals for use in Viscose rayon factory, here. Estimated cost $1,000,000.

Ont., Hamilton — KNITTED GOODS FACTORY — Zimmerknit Mills, Ltd., will soon receive bids for a 3 story, 50 x 150 ft. addition to factory on Dundurn St. Estimated cost $50,000. A. Beard, c/o owner, is engineer.

Ont., Regina—AUTOMOBILE FACTORY—General Motors Co., H. A. Brown, Mgr., Oshawa, will receive bids about June 12, for a 1 story, 400 x 800 ft. factory, here. Estimated cost $1,000,000. Hutton & Souter, 6 James St. S., Hamilton, are architects.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

THERE is marked upward tendency in June prices, compared with last month's levels. Leather belting rose 10 per cent, May 31, affecting contracts closed after that date. The hide and leather market advanced in December, 1927, and has moved steadily toward higher levels since then. Other notable price increases occurred in wiping cloths, boiler rivets, armored cable, and rubber-covered copper wire.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket		(net) 68c. per ft.
Common, 2½-in., cotton, rubber-lined	80c. per ft. list, less	50%

Air—Best grade			
¾-in., per ft.	3-ply $0.36½	4 ply	$0.44

Steam—Discounts from List			
First grade 30-10%	Second grade 40%	Third grade	45%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade	45%	Second grade	50%

LEATHER BELTING—List price, 24c., per lin.ft. per inch of width, for single ply, at New York warehouses:

Grade	Discount from list
Medium	31½%
Heavy	27%

RAWHIDE LACING—For cut, best grade, 30-10%; 2nd grade, 50-10%. For laces in sides, best, 46c. per sq.ft.; 2nd, 42c. Semi-tanned, cut, 30-10%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$0.90
Asbestos for high-pressure steam, ⅛ in.	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.55
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts, New York warehouses, are as follows:

85% magnesia high pressure		50%
Asbestos, air cell, for low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.25@$2.35 per bbl. without bags, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.30 per 100 lb. in lots of 250 to 3,999 lb.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	10.00@13.50	16.00	15.00
Colored	9.00@13.00	12.00	12.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed, white wipers, as follows:

Chicago	$0.17
New York	.16½@.17½
Cleveland (*per thousand*)	$8.00

LINSEED OIL—These prices are for raw oil in barrels, f.o.b., in 1 to 4 bbl. lots:

	New York	Cleveland	Chicago
Per pound	$0.012	$0.107	$0.112

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry	In Oil
Red	$13.25	$14.75
White	13.25	13.25

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

Tank rivets, small, including ⅞-in. dia., list (Apr. 1, 1927) less 50-10% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ¾-in., per 100 lb.:
New York $5.00* Chicago $3.60 Pittsburgh mill $2.90

Cone-head boiler rivets, ½-in., per 100 lb.:
New York $5.00* Chicago $3.60 Pittsburgh mill $3.00

*Price is for full packages; broken package lots, $6.50 net, delivered.

REFRACTORIES—Prices in car-loads, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome cement, 40@50% Cr_2O_3, in bulk	per net ton	22@25
Chrome cement, 40@50% Cr_2O_3, in sacks	per net ton	26@29
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa.	per M	43.00
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38
Chrome ore crude, 40@50%	per net ton	18.00@22.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	70.75
Commercial genuine, intermediate grade	53.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.00

COLD DRAWN STEEL—Shafting and screw stock, warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.40	$3.65	$3.60
Flat or square	3.90	4.15	4.10

BOILER FITTINGS—F. o. b. New York or Jersey City, discounts from list:

	Current
Copper ferrules	70%
Boiler flanges	65-5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following discounts are for carloads at Pittsburgh mill:

BUTT WELD

	Steel Black	Steel Galv.		Iron Black	Iron Galv.
Inches			Inches		
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 and 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

BOILER TUBES—Following are net prices per 100 ft. at New York warehouses on tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17.07
1¼	.....	.....	19.20
1½	.....	$38.00	17.92
1¾	.....	28.50	20.48
2	$17.33	25.00	20.24
2¼	19.84	28.25	23.00
2½	21.60	34.00	26.03
3	25.50	42.50	27.04
3¼	30.25	49.50	30.67
3½	31.50	52.75	33.33
4	38.03	67.00	40.11

Tubes 2½ in. diameter, or smaller, over 18 ft. long, 10 per cent extra.

These prices are net, per 100 ft., based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

2 in. and smaller.. 5c. per cut. 3 in..... 9c. per cut.
2¼ and 2½ in..... 6c. per cut. 3½ to 4 in.... 10c. per cut.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent. 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft.
No. 14 solid	$30.00 (net)	$44.00 (net)	$180.00	$220.00
No. 12 solid	136.00	180.00	225.00	275.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	305.00	375.00	420.00	500.00
No. 6 stranded	440.00	530.00	615.00	.....

From the above lists discounts are:		Lead Covered
Less than coil lots	50%	30%
Coils to 1,000 ft.	60%	35%
1,000 to 5,000 ft.	65%	38%
5,000 ft. and over	67%	40%

CONDUIT—Price per 1,000 ft.; **ELBOWS AND COUPLINGS**, per 100 pieces, extra f.o.b. New York warehouse. Discount of 5 per cent. for payment in 10 days. Delivery charges, approximately 4 per cent. additional.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
½	72.07	78.63	10.21	11.63	6.46	7.03
1	103.31	113.00	15.10	17.21	8.39	9.13
1¼	139.77	152.88	20.51	23.07	11.78	12.75
1½	167.12	182.79	27.34	30.76	14.56	15.75
2	224.85	245.94	50.13	56.40	19.41	21.01
2½	355.50	388.85	82.03	92.28	27.73	30.01
3	464.88	508.50	218.74	246.10	41.59	45.01
3½	585.30	637.74	483.04	543.46	55.46	60.02
4	714.17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy	$17.20
No. 16 cotton reinforced heavy	21.00
No. 18 cotton reinforced light	13.20
No. 16 cotton reinforced light	17.60
No. 18 cotton Canvasite cord	14.60
No. 16 cotton Canvasite cord	16.90
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$72.00 *80.00
No. 14 super service cord or similar (2 wire) in 1,000 ft.	110.00 *122.00

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.,	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100 amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 64%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4.00	5.00	25	5
225 to 400-amp.	7.50	11.00	25	1
450 to 600-amp.	11.00	16.00	10	1
REFILLS—				
1 to 30-amp.	$0.03 ea.	$0.05	100	100
35 to 60-amp.	.05 ea.	.06	100	100
65 to 100-amp.	.10 ea.	.10	50	50
110 to 200-amp.	.15 ea.	.15	25	50
225 to 400-amp.	.30 ea.	.30	25	25
450 to 600-amp.	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken carton	5%
Unbroken carton but less than standard package	22%
Standard package	40%
Discount Without Contract—Renewals:	
Less than standard package	Net list
Standard package	40%
Discount With Contract—Fuses:	
Broken cartons	10%
Unbroken cartons but less than standard package	26%
Standard package	42%
Discount With Contract—Renewals:	
Less than standard package	Net list
Standard package	42%

FUSE PLUGS, MICA CAP—

0-30 ampere, standard package (500)	$2.50
0-30 ampere, less than standard package	2.80

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt Watts	General Type	Price Each	200—260 Volt Watts	Special Type	Price Each
15	A 17	$0.23	25	A 19	$0.28
25	A 19	.23	50	A 21	.28
40	A 21	.23	100	A 23	.50
50	A 21	.25	....	....	....
60	A 21	.25	...	....	....
100	A 23	.40	....	....	....

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$5.90	$9.20	$10.85	$17.60
12	9.70	12.40	14.00	23.75
10	12.95	16.00	18.10	30.80
8	19.00	21.95	23.50	42.90
6	.....	.....	34.00	.....
4	.....	.....	46.90	.....
2	.....	.....	65.10	.....
1	.....	.....	91.00	.....
0	.....	.....	114.00	.....
00	.....	.....	133.00	.....
000	.....	.....	157.00	.....
0000	.....	.....	191.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	½ In. or Pendant Cap Key	½ In. or Pendant Cap Keyless	½ In. or Pendant Cap Pull	¾ In. Cap Key	¾ In. Cap Keyless	¾ In. Cap Pull
Standard package	$0.11	$0.11	$0.18	$0.16½	$0.15	$0.22
Unbroken carton	.14	.13	.20	.18	.16	.23
Broken carton	.16	.15	.22	.20	.18	.25

WIRING SUPPLIES—

Friction tape, ¾ in., less than 100 lb., 31c. per lb.	100 lb. lots	29c. per lb.
Rubber tape, ¾ in., less than 100 lb., 33c. per lb.	100 lb. lots	31c. per lb.
Wire solder, less than 100 lb., 33c. per lb.	100 lb. lots	31c. per lb.
Soldering paste, 2 oz. cans		$1.00 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:	
Less than $25.00 list value	30%
$25.00 to $50.00 list value	30-5%
$50.00 list value or over	35%